NIRDA
National Industrial
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NATIONAL INDUSTRIAL RESEARCH AND DEVELOPMENT AGENCY

TECHNOLOGY AUDIT
OF POULTRY VALUE CHAIN REPORT

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EXECUTIVE SUMMARY

Poultry farming in Rwanda has been identified as a production enterprise with the potential to expand if well exploited. To exploit this potential, the Government of Rwanda over the past years adopted a number of policies and strategies to support poultry value chain sector businesses to tap into this resource notable among them are the recently Rwanda Livestock Master Plan (2017-2022) proposes specific interventions to transform the poultry industry and the Strategic Plan for the Transformation of Agriculture in Rwanda-PSTA4 (2018-2024). These strategies identified investment interventions for improving poultry sector development.

It is against this background that NIRDA with support from ENABEL contracted SORWAFFA Ltd to conduct a technology audit of poultry value chain (PVC) in Rwanda with the aim of establishing the current available technology and technological capability as well as updating the mapping of poultry value chain actors and their roles and to assess the organization and the current available technology and technological capacity levels of poultry value chain actors.

The study design used both qualitative and quantitative approaches.

The study found out that the population of chicken has increased from 3.5 million in 2010 to 7.6 million in 2018 showing an increase of 54% in the last 8 years (RAB, 2018). A number of poultry businesses such as commercial poultry farmers, feed processors, hatcheries and agro-dealers have sprung up throughout the country. This has created jobs, generated revenue to government, contributed to improvement in nutrition and generally uplifted the social-economic conditions of their members and their local communities.

The study identified the following technology gaps:

i. Lack of specialized skills/low technology uptake and poor application of regulatory standards and lack of standard poultry housing systems.

ii. Lack of standard poultry housing systems. Most commercial farmers generally do not use modern poultry housing system and this affects the quality of meat and eggs, and reduces chances of accessing premium prices and export markets;

iii. The hatcheries are not fully operational due to low capacity of incubators thus poor capacity to meet farmers demands; Hatchery companies lack parent stock and often relay on imported fertilized egg;

iv. Feed processors operate under capacity because of inadequate supply of raw materials and together with costly imported raw material ingredients leads into production of expensive feeds.

v. Inadequate technical skills and financial capacity as well irregular supply and costly DOCs.

vi. Low level of adoption and use of the improved technologies in poultry value Chain.The poultry products (meat and eggs) are of high demand but they are not competitive on the market. The cost of inputs is the main factor driving the cost of doing business high compared on regional poultry products.

vii. Like the other sub-sectors in agriculture, the poultry industry is constrained by lack of capital investment. Conventional financial institutions are reluctant to provide loans to farmers thus limiting investment in PVC.

viii. Poor extension and veterinary services delivery to PVC and poor supply for vaccines and essential veterinary drugs to PVC actors;

ix. Regional competition with similar products from the region is a big threat to the industry as the regions continues to produce cheaper poultry products.

x. Weak poultry sector regulations, standards and certification.

Based on the current PVC technology gaps and challenges the study recommendation following strategic interventions in order to upgrading the PVC industry as well as its efficiency and competitiveness.

i. There is a need to put in place national regulatory poultry housing standards for poultry farmers.

I. There is a need to put in place practical and actionable implementation procedures and monitoring tools and enforcement procedures to ensure the regulatory standards are in place and full enforced.

ii. Promote and support the adoption of improved housing practices and labor-saving techniques for chicken farming this will reduce mortality, predation this will positively impact poultry production.

iii. Apply 4Ps Model. The public, private and producers partnership is financing model which will allow poultry value chain to be financed jointly by several actors involved in PVC, namely the private actor who buys and sells the production, the poultry value chain enterprises and the public sector which supports the value chain of that production. 4Ps model allows putting in place all necessary measures to control and making a close follow up of each step of investment and render the beneficiary more accountable to the use of grant and this promotes profitability as well as sustainability of the poultry enterprise/investment.

iv. Establishment of the Center of Excellence which will strengthen technological capacities of PVC actors.

v. The study recommends contract farming system between feed processors and poultry feed ingredient growers and suppliers in order to solve the problem of imported ingredients. Feed processors should establish large scale stocking system that would accommodate stock during harvest time.

vi. RSB should enforce the existing poultry feed processing standards.

vii. Feed processors and feed distributors (agro dealers) should be supported quality and timely services to poultry farmers.

viii. Ope-rationalize and enforce the existing regulatory standards of poultry production, processing and transport to ensure poultry products meet the standards that are required by the market (local and international).

ix. Promote and support the establishment of contract between PVC operators and their input suppliers/providers with arrangements for local supply and to comply with the quality standards.

xi. Support the development of information systems providing value chain actors with latest market trends and other relevant news, through all available systems e.g radio or mobile phones.

xii. Develop new partnerships between PVC actors to improve collection and aggregation of PVC products via poultry product collection centers (PPCCs) at district levels allowing remote farmers to send products to urban centers.

xiii. There is a need to develop PVC specialized skills curriculum or hands-on training modules for each PVC actor based on outcome from the skills assessment.

xiv. Facilitate the development of poultry market by:

a) organizing commercial poultry farmers, processors and traders of poultry producers into a traders' associations to enable them lobby and advocate for better prices, look for markets locally and outside,

b) supporting them to acquire cold chain infrastructure and support existing producers and processors of poultry products to acquire equipment to cut and process meat, properly handle and process eggs,

supporting branding, marketing and better ways of sales promotion.

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LIST OF ABBREVIATIONS AND ACRONYMS

BDF	:Business Development Fund
DARO	:District Animal Resource Officer
ENABEL	:Belgian Development Agency
FDA	:Rwanda Food and Drugs Authority
FGDs	:Focus Group Discussions
IFAD	:International Fund for Agriculture Development
ILRI	:International Livestock Research Institute
KIIs	:Key Informant Interviews
MFIs	:Micro Finance Institutions
MINAGRI	:Ministry of Agriculture and Animal Resources
MINICOM	:Ministry of Trade and Industry
NGOs	:Non-Governmental Organizations
NIRDA	:National Industrial Research and Development Agency
NST1	:National Strategy for Transformation
RICA	:Rwanda Inspectorate, Competition and Consumer Protection Authority
R-LMP	:Rwanda livestock master plan
RPIA	:Rwanda Poultry Industry Association
RSB	:Rwanda Standards Board
SACCOs	:Savings and Credit Cooperatives The Strategic plan for Agriculture
PSTA4	Transformation (IV)
SPSS	:Statistical Package for Social Science
VAT	:value added tax

1. INTRODUCTION

Poultry farming in Rwanda has been identified as a production enterprise with a promising future. To exploit this potential, the Government of Rwanda over the past years adopted a number of policies and strategies to support farmers and private sector businesses to tap into this resource. Previous strategies such as Economic Development and Poverty Reduction Strategies—EDPRS 1 (2008-12) and EDPRS-2 (2013-18), the Strategic Plan for the Transformation of Agriculture in Rwanda-PSTA 3(2013-2018) and PSTA 4(2018-2023) generally supported modernization of agriculture in an attempt to increase productivity hence contributing to improved food and nutrition security, incomes and contribution to national development. However, the strategy and investment plan to strengthen the poultry industry in Rwanda (MINAGRI, 2012) and the recently Rwanda Livestock Master Plan (ILRI, 2017) proposes specific interventions to transform the poultry industry. One such intervention is providing technical assistance to poultry farmers to increase the production and then link them to private investors such as feed processors, hatcheries and products and by-products processors that serve as either suppliers of inputs such as Day Old Chicks and Feeds or market for poultry products such as eggs and meat.

This transformation of the poultry industry is believed to have the potential to contribute to national food and nutrition security, income generation, job creation as well as economic growth. For Example, the Rwanda Livestock Master 2017 indicates that with the recommended investment of US $ 61.4 Million (19.7 public & 41.7 private) over a 5-year period in the development of chicken value chain, the subsector would generate an increase in meat and egg production by 124% and 110% respectively compared to 2016 base year (LMP, 2017). This would significantly contribute to increased production hence meeting all the national meat requirement as well as increase per capita egg consumption hence meeting her development objective of improving food and nutrition security.

The Master plan identified investment interventions for improving animal genetic material, feeds and health services as well as policy options to complement them.

To attract private investments in the poultry value chain to fast truck the attainment of investment and production targets, financial incentives such as VAT and Income tax exemptions have also been introduced. It is also anticipated that these incentives will encourage private investments into the industry hence create jobs, contribute revenue to the government, lower consumer prices due to increased production hence increase egg and meat consumption improving nutrition. This will lead to the attainment of the national development plan targets in the key livestock value chains.

It is against this background that SORWAFFA Ltd was contracted by ENABEL on behalf of NIRDA to carry out a study whose objective is detailed below.

1.1 General objective of the study

The general objective of the study was to conduct a technology audit of poultry value chains in Rwanda with the aim of establishing the current available technology and technological capability as well as updating the mapping of poultry value chain actors and their roles.

1.2 Scope of the assignment

The study focused only on the commercial poultry farmers, hatcheries and seed producers, poultry products processors, wholesale distributors/retailers/end consumers, all value chain service providers (feed processors, agro-dealers, poultry products transporters) and enablers. It undertook an assessment of external environment affecting the poultry value chain, the trend of the industry in and out of the country for comparison and possible replication of best practices. The technologies used and technology gaps for all stakeholder performance were also assessed.

1.3 Justification for the study

The poultry value chain has been identified as a key priority that can greatly contribute to national development (R-LMP, 2017). It has been chosen because it has the potential to contribute to inclusive growth hence offering the opportunity to improve the livelihoods of small holder farmers in the rural areas by connecting them to those involved in value addition and to final markets; contribute to addressing the malnutrition challenge; raise income for those involved; reduce imports while expanding exports of poultry products.

The development of poultry value chain which is also resilient to climate change is expected to benefit more women and potentially youth as producers, service providers, entrepreneurs, laborers and consumers.

In terms of nutrition, poultry especially specialized broiler units can play an important role to raise Rwanda’s meat per capita consumption estimated to be 7.9 kg which is far below FAO’s recommended rate of 37kg. It is therefore in this regard that National Industrial Research Development Agency commissioned a study to undertake a detailed audit of technologies used in the poultry value chain for the improvement of the livelihoods and incomes of poultry farmers and other key stakeholders while creating stronger market linkages along all the key components of the poultry value chain.

Therefore, the study assessed the organization and the current available technology and technological capacity levels of poultry value chain actors (large, medium and small scale poultry value chain actors and enablers) covering wide issues related to poultry production, hatcheries, chicken feed, agro-dealers, transporters, processors, poultry traders, and access to credit.

It also assessed the value chain potential for upgrading (move to a higher value added component of a value chain), extending (actions to broaden an existing value chain to increase its full potential for job creation and value added impact) and optimizing (actions to improve operation of certain links of the value chain to achieve greater value added).

Finally, poultry value chain enablers (public and private institutions) that support the poultry value chains were identified and their roles and responsibilities were analyzed with respect to the promotion of poultry value chain towards upgrading poultry value chain technological capacities and proposed Strategies and implementation approach for their efficiency and effectiveness.

2. STUDY DESIGN AND METHODOLOGY

2.1 Study design

The proposed study design used both qualitative and quantitative approaches as detailed below. Secondary data was collected from existing documents both published materials and grey literature obtained from different stakeholders in the public and private sector consulted while primary was collected through stakeholders’ interviews and key informants using structured questionnaire, interview guides, focus group discussions and personal interviews guided by a checklist developed for this purpose. The interviews covered relevant stakeholders in the poultry value chain sector including large scale producers, poultry products processors, hatcheries owners and poultry seed producers, public and private enablers involved in poultry development like government ministries and departments responsible for commercial poultry development, banks, microfinance institutions and insurance companies.

2.1.1 Qualitative approach

The qualitative assessment involved conducting meetings and discussions with different poultry value chain stakeholders using a guide designed and aligned to the questions developed. During field work, a group of participants were invited to the Focus group discussions (FGDs) sessions and discussions held to get firsthand information of poultry value chain technological capacities, challenges and possible strategies for improvement.

2.1.2 Quantitative approach

The structured questionnaire was designed and used to collect quantitative data from the poultry value chain actors selected in all 30 districts of Rwanda by use of enumerators. Here information was provided by owners of the firms as well as the business senior members, technical, finance and administrative staff.

2.2 Data collection methods

2.2.1 Secondary data collection

Secondary data was conducted through literature review from official documents and websites of stakeholder institutions both public and private such as MINAGRI/RAB, RICA, RSB, MINICOM, NIRDA, Rwanda FDA, REMA, IFAD, FAO, BDF, MFIs, PSF, Commercial Banks and districts Business Development department, private companies etc.

A number of government livestock policy and strategy documents were reviewed. These include PSTA 4, NST1-7YGP, Poultry Industry in Rwanda, Rwanda Livestock Master Plan, relevant ministries and departments annual reports, text books on poultry, published papers and articles, journals, project and firm reports from the aforementioned Poultry value chain stakeholder institutions.

In addition, the use of internet to tap into the wider spectrum of knowledge on poultry industry around the world were consulted with specific on technological advancement in the poultry value chain. The consultancy team engaged ENABEL, RAB, MINAGRI, MINICOM, NIRDA and local partners to identify and source relevant and latest documents for in-country documentation review.

2.2.2 Primary data collection

Primary data was collected for the purposes of corroborating the secondary data collected during the desk review. This exercise was done through participatory approach to capture qualitative information required. Qualitative participatory approach allowed exploring and understanding respondents' point of views and interactions with regard to technological capabilities along the poultry value chain. The approach brought out target groups' valuable insights regarding people's subjective perceptions.

For the purposes of coming up with informed qualitative data, the study used observation during field visits, in-depth Key Informant Interviews (KIIs), and Focus Groups Discussions (FGDs).

a) Key Informant Interviews (KIIs)

To gain stakeholders' perspectives on the current operation along the poultry value chain sub-sector, the Key Informants Interviews played a useful role in verifying quantitative data and providing valuable context in order to understand the findings from qualitative surveys. These included firms owners and 3 managers of the poultry value chain actors as well as relevant policy stakeholders. Key-informants interviewed were drawn both from both central and decentralized levels such as MINAGRI, RAB, MINICOM, NIRDA, BDF, ENABEL, IFAD, RICA, FDA, REMA, RSB, RPIA, PSF, RDB, RCVD, Districts and private companies supporting poultry value chain.

b) Focus Group Discussions (FGDs)

Focus Group discussions were organized in all 30 districts of Rwanda to collect valuable qualitative and quantitative information from different stakeholders including poultry value chain actors such as commercial poultry farmers engaged in poultry production (medium and small scale layer and broiler farmers), poultry value chain inputs and services providers such as poultry products transporters, wholesalers/distributors and retailers, feed processors and agro-dealers.

Information collected from FGDs mainly focused on poultry value chain technological capacities, challenges and possible strategies for improvement.

c) Observation Checklists

To complement other tools, the study team used checklists to observe and take note of the level of technology adoption and condition of infrastructure and technologies in the poultry value chain study area. The observations validated or discounted information obtained from other sources.

2.3 Population and sample size

2.3. 1 Population of the study

Due to small number of poultry value chain actors in all 30 districts all large commercial farmers were interviewed and 50% of the rest invited to focus group discussions (FGDs). Poultry value chain stakeholders were identified with the support from DAROs, NIRDA and other partners in the study. DAROs were continuously engaged to provide updated lists of all selected value chain stakeholders within their respective districts. In order to ensure that all poultry value chain actors and enablers, all 30 districts were fully mapped and updated, consultations with the following departments:

- Private sector federation (PSF) through the Rwanda Poultry Industry Association (RPIA);
- District Animal Resource Officers (DAROs) to ascertain all registered value chain stakeholders and;
- MINAGRI livestock unit.

Selection also included programme and technical staff in each selected value chain actors and enablers such as MINAGRI, RAB, MINICOM, RICA, FDA, Banking Institutions (Commercial banks, SACCOs and Microfinance), BDF, RPIA, PSF. Gender and youth were considered while doing the selection.

2.3.2 Sample Size Selection

First, reference to the desk review from obtained documentation from RAB and other partners in inception preparation, the consultant found out that the population of the targeted poultry value chain actors was not well known and rare and no pre-calculated list of target population details. Therefore, the consultant used chain-referral sampling using a non-probability sampling technique. This is a sampling technique, in which existing subjects provide referrals to recruit samples required for a research study. In order to obtain a list of above poultry value chain actors, the consultant used the Linear

Snowball Sampling. This was be done through engaging the RAB/DARO and the poultry farmers who were the entry point in the study to obtain the group of value chain actors (poultry products transporters, agro-dealers, wholesalers/distributors and retailer traders, poultry products and by-products processors, feed processors, hatcheries) in each district. The formation of a sample group started with the above individuals (poultry farmers and DAROs) providing information about just one other subject and then the chain continued starting with only one or two referral from one subject. This pattern continued until enough number of subjects was available for the sample.

In agreement with NIRDA, all the large scale farmers (i.e. 100%) were interviewed. In addition, 50% of the middle scale farmers, one small scale farmer per each sector in every district as well as 100% of inputs and services providers were invited to participate in FGDs countrywide. . To get to these farmers, systematic sampling technique was used.

The table 1 below illustrates the categories of poultry value chain actors, their estimated population size and the sample that was interviewed or invited to FGDs per each category.

Table 1: Population and sample size for for PVC stakeholders

a. Commercial layer and broiler farmers			
Category	Number of chickens	Population	Sample size
Small scale	100 – 999	328	141
Medium scale	1,000-4,999	`183	127
Large scale	5000+	36	36
b. Poultry Inputs and Services providers			
VC Category	**Population**	**Sample Size**	Method of Population verification
Agro-dealers	84	84	DARO RPIA District Representative
Wholesalers /retailers	23	23	DARO RPIA District Rep
Feed processors	12	12	DARO RPIA District Rep.
Transporters	7	7	DARO RPIA District Rep
c. Poultry Products and By-products Processors & Hatcheries			
VC Category	VC Population	Sample Size	Method of Population verification

Modern/semi modern Processors (meat, eggs & by-products)	6	6	DARO RPIA District Rep.
Hatcheries /or seed producers	30	30	DARO RPIA District Rep.
d. Poultry Value Chain Enablers (Regulators/Sponsors and Supporters)			
VC Category	**Population**	**Sample Size**	**Method of Population verification**
Regulators/Sponsors (Private &Public)	-	1-2 representatives/institution	DARO RPIA District Rep.
Supporters (Banks, MFIs, Insurance companies)	-	1-2 representatives/institution	DARO RPIA District Rep.

2.4 Recruitment and Training of Data Collectors

The consultant firm recruited enumerators to conduct field visits for data collection. All data collectors were given a detailed training session on how to conduct interviews, fill in the data collection tool, use the tool for data entry in the computer. The entire raw data collected was computerized into database for processing and analysis. Enumerators visited and collected from all 30 districts

2.5 Pre-Test

The training of field staff was followed by a pilot survey to pretest the questionnaire and this was done under the supervision of team leader. The purpose was to improve the questionnaire according to the errors and constraints encountered in the field. The questionnaire was in both English and Kinyarwanda.

2.6 Data Presentation, Analysis and Interpretation

After data collection, the raw data was edited to ensure that it was free from inconsistencies and incompleteness. This process involved a scrutiny of the completed instruments in order to detect and reduce as much as possible errors, incompleteness, misclassifications and gaps in the information obtained from the respondents eliminating any unusable data.

Raw data collected was coded, sorted and arranged following the study questions. After coding, sorting, arranging and cleaning up of the raw data, analysis and interpretation was done. The data was analyzed using the most recent version of the Statistical Package for Social Science (SPSS) version 21. Logic regression, analysis of variance, cross tabulations and other descriptive methods were used whenever appropriate. A descriptive statistical analysis focusing on the characteristics of the comprehensive measurement of the study components was carried out. Inferential tests were undertaken, testing both the group differences and the association test to find out the relationship between two or more variables.

2.7 Validation of the results

After data analysis and interpretation of the results, the technological audit report was produced and a validation work shop will be organized at the end of the assignment where findings and recommendations from the assignment will be presented and discussed and the outcome and recommendations from the workshop will be part of the draft report.

The draft report will be presented to NIRDA/ENABEL/RAB Management for final approval for finalization of the final report with comments and inputs incorporated from the draft report validation workshop.

3. SITUATION ANALYSIS OF THE POULTRY VALUE CHAIN IN

RWANDA 3.1 Global context of poultry farming technology

The theoretical framework is charged with the primary purpose of outlining how the usage of technology in poultry farming has been applied in achieving objectives of firms in Rwanda. Further analysis will cover how technology has been used in poultry farming in developed nations, which has shown an increased production and reduced waste. An analysis of the past application of the technology will provide the background in which judgment on adoption of technology in poultry farming will be based, and what to select and what to leave out during selective borrowing. This will offer a better understanding, using evidence, on the importance that underlies Rwanda if it adopts technology in poultry farming.

Poultry farming using technology is dependent on the use of scientific knowledge, innovative approaches and experience of farmers. Over the years, modern breeding of poultry has been applied with a view of improving poultry breeds. Sophisticated technologies are required for the accomplishment of the target. In light to improved breeds, and output, appropriate technology and a team of specialists are required (Loyon et al., 2016). For instance, Bauer Technics, a company specialized in poultry farming boasts of applying technology in its operations, with the inclusion of construction engineers, feeding specialists, and veterinarians with services in both the Czech Republic and the world over. Therefore, a properly organized modern poultry farm must consider both the basic needs of the poultry animals as well as be in harmony with their genetic potential of the animals by employing specialist in operations.

The recent trend in the usage of technology in poultry farming has received both positive and negative feedback. Developed nations tend to adopt technology in poultry farming operations, while developing nations tend to be reluctant in inculcating technology. Developing countries seldom allocate time, resources and effort in learning the needs and importance that technology holds, especially in the poultry industry. Such nations remain stuck in the old traditional methods, with little technological application. This makes them lag behind as per the current changing trend in business operations. In countries where technology in poultry farming is largely practiced, such as in Europe, certain factors determine individual poultry farms design. The factors include the condition of the landscape, farm zoning, the delivery system for farm feeds, the ventilation system, and efficient ways of collecting, storing and utilizing compost (Loyon et al., 2016).

On landscape consideration, construction of poultry shelters is based on corresponding climatic conditions and other regional requirements. Farm zoning, on the other hand, requires that poultry farms be set up in areas with efficient road and driveway connections. The design of the ventilation system is dependent on the needs for cooling and heating ideal for the poultry. Poultry farms range from small scale to medium size, and large scale. Large scale farms are mostly found in Europe, where technology has been applied to ease on work, and increase output while maximizing on efficiency. Medium and small-scale poultry farms are found mainly in the third world countries, where traditional methods of farming are applied. Although the conventional methods are not efficient, they ensure the continued production of poultry products.

However, some developing countries have adopted technology in poultry farming. The biggest problem such countries face is high poverty levels and lack of government support in the form of subsidies, loans, and a weak economic background that curtail the application of the available technology in poultry farming. Majority of poultry farms utilize traditional methods, where an outbreak of diseases is capable of sweeping off all the poultry birds. Therefore, these farmers lack the necessary tools to mitigate disease outbreak. Consequently, these farms are still using traditional methods of chick production, rearing, and storage. Marketing is often locally conducted. This therefore, places the poultry industry in the third world as a local, small scale business endeavor.

Technology in poultry farming is a new topic, and after the study, it will enable poultry farmers to see the need for inculcating technology in their business endeavor. The distinction in poultry farming will therefore, come to light. Technology in poultry farming has been harnessed and supported by governments in developed countries such as Finland, thereby leading to a boost in the poultry sector. Technology in poultry farming goes further than just involving disease control measures to the development of better chick breeds, efficient method of storage of produce, better feeds, and better ways of sales promotion. The inclusion of technology in poultry farming has not only led to an increase in production but also leads to ease in rearing, harnessing and distributing poultry by-products.

3.2 Poultry production in Rwanda

3.2.1 Context of poultry subsector development

Rwandan high population density and increases in urban migration have increased demand for food including meat and eggs. This has led to a focus on farming systems and/or enterprises that maximize yield per unit area and input and poultry production has been identified as one of the enterprises that falls within this category. Meat and egg consumption in Rwanda is below the food requirement recommended by FAO and WHO.

Commercial poultry farming is an interesting undertaking to Rwanda because of its size (26,338 square kilometers) and a high population of about 12.5 million people (GoR, 2018). However, its economy that is highly dependent on subsistent agriculture, weak manufacturing sector and high poverty levels has hindered adoption of high input technology.

Rwanda being a member of East African Community (EAC) with a market size of 143 million consumers as well as a member of the Common Market for Eastern and Southern African (COMESA) with a population of over 400 million is an added advantage as this would offer much needed market for poultry products. However, these products must be competitive. There is also a huge market potential in Democratic Republic of Congo which can boost poultry exports if adequately exported.

The growing Rwandan economy since 2000 is yet another boost for poultry farming. Although the country has a troubled past, it has since the 1994 Tutsi genocide maintained stability and embarked an ambitious development agenda whose goals are defined in its Vision 2020 strategy as well as NST1. These strategies seek to transform the country from a low-income, agriculture-based economy to a knowledge-based, service-oriented economy with middle-income country status by 2020 with an annual per capita income of US$ 1240, a poverty rate of 20% and an average life expectancy of 66 years. During this period the country successfully implemented two five-year Economic Development and Poverty Reduction Strategies—EDPRS 1 & 2 registering robust economic and social performances.

According to World Bank reports, the country has over the last decade registered considerable social-economic transformation using own resources as well as support from development partners. It registered an average growth of 7.5% over the decade to 2018, while per capita growth domestic product (GDP) grew at 5%. Strong economic growth resulted into significant improvements in living standards, with a two-thirds drop in child mortality and near-universal primary school enrolment as well as meeting most of the Millennium Development Goals (MDGs), poverty rate dropped from 44% in 2011 to 39% in 2014, while inequality measured by the Gini coefficient fell from 0.52 in 2006 to 0.43 in 2017.

Rwanda recently upgraded her transformation journey and now wishes to become Middle Income Country (MIC) by 2035 and High-Income Country (HIC) by 2050 and this offers an opportunity for adoption of technology in poultry farming. Theses aspirations will be carried out through a series of seven-year National Strategies for Transformation (NST) that will be implemented by detailed sectoral strategies that are aimed at the achievement of the Sustainable Development Goals.

3.2.2 Existing Policy Framework

Policy actions that guided Rwanda's agriculture transformation since early 2000 were drawn from the Vision 2020 whose implementation mechanism were 5-year Economic Development and Poverty Reduction Strategies (EDPRS) that were subsequently implemented through Strategic Plans for Agriculture Transformation (PSTA). Both the Vision 2020, EDPRS, and PSTA identified Productive high value and market oriented agriculture as a top priority and aspired that Rwanda's subsistence agriculture will have been replaced by a fully, commercialized agricultural sector by 2020.

The successful achievements of vision 2020 aspirations led to the adoption of Vision 2050 and its implementation vehicle, the National Strategy for Transformation 1 (NTS1). The Economic Transformation Pillar of the National Strategy for Transformation (NST1) 2017-2024 has identified the need to accelerate private-sector-led economic growth and increased productivity. The priorities of this pillar include establishing Rwanda as a globally competitive knowledge-based economy, promoting industrialization and attaining a structural shift in the export base to high-value goods and services with the aim of growing exports by 17% annually as well as modernizing and increasing the productivity of agriculture and livestock.

Drawing from the above priorities set by NST1 and experience of the implementation of previous sector plans, PSTA 4 as well as the R-LMP, 2017 assigned poultry a prominent role and bigger targets and ambitions. This is because previous experience indicated that poultry has a short production cycle and a unique ability to convert a wide range of agricultural-food by-products into valuable meat and eggs, requires less space, small starting capital, offers decent employment especially to youth and women and can be sold in times of crisis and act as household insurance for small farmers hence making it a key contributor to food and nutrition security and a major asset to poverty alleviation.

Due to these factors both PSTA4 and R-LMP re-emphasized poultry farming as one of the avenues to contribute to national food and nutrition security, income generation, job creation as well as economic growth. They set out the investment interventions to improve animal genetic material, animal feeds and animal health as well as creating policy environment that support the whole value chain. In addition, plans were drawn to transition the chicken value chain from largely subsistence to a more knowledge intensive market oriented sub-sector adding growth and value to poultry products. Both the family and specialized commercial operations will be transformed through the use of improved and highly productive breeds. This will ensure household food and nutritional security and higher incomes and significantly contribute to achieving the all-meat consumption needs of the nation.

3.2.3 Poultry Production system and poultry production figures

The Rwandan poultry industry is characterized by dual system namely the traditional village chicken production system and the commercial specialized chicken production. The traditional village chicken production system involves the rearing of Traditional Family Chicken (TFC) while the commercial specialized chicken production (SP) involves the rearing of high yielding exotic poultry breeds. It relies on importing exotic parent and grandparent stock and is business oriented. The SP system is further divided into layer mainly for eggs production and broiler subsystems for meat production.

On other hand the traditional village chicken production system is an extensive system where chicken scavenge around the homestead and requires less inputs from the owner. Chicken under this system can be improved or cross bred into Improved Traditional Family Chicken (ITFC) and Cross Breed Family Chicken (CFC) sub systems.

The commercial specialized chicken production system is highly efficient producing more meat and eggs per chicken compared to the traditional village chicken production system. While the Traditional Family Chicken (TFC) constituted 75% of the chicken population in 2017, they produced only 32% of the chicken meat and 34% of the eggs. Sixty-eight percent (68%) of the chicken meat came from specialized broilers and layers and 66% of the eggs from specialized layers which collectively constitute 25% of the total chicken production.

3.2.4 National planned targets

According to Rwanda Livestock Master Plan (ILRI, 2017) with an investment of US $ 61.4 million spread over a period of five years, Rwanda hopes to increase poultry meat and eggs by more than two times annually producing 35,000 tons in 2021/2022 from 15,200 tons in 2016/2017 of chicken meat and 513,000 eggs in 2021/22 from 244,000 eggs in 2016/2017. This increase was expected to be driven by

Commercial Specialized Chicken Production both layers and broilers though this constituted 32% in 2016/2017.

The above targets were also expected to be achieved by facilitating the rearing of the Improved Traditional Family Chicken (ITFC), Crossbreed Family Chicken (CFC) and expanded Specialized/Commercial Chicken (SP) systems – with Layers and Broilers. The details of the above planned targets are indicated below.

Table 2: Planned Poultry targets

Subsysstem of poultry production	Quantity	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
SP layers	No of Chicken in Million	0.8	0.9	1.0	1.2	1.4	1.6
SP broilers	No of Chicken in Million	1.0	1.2	1.4	1.7	2.0	2.4
S/total SP	No of Chicken in Million	1.7	2.1	2.4	2.9	3.4	4.0
ITFC+CFC	No of Chicken in Million	5.2	5.5	59.0	6.2	6.6	7.1
Total	**No of Chicken in Million**	**6.9**	**7.6**	**61.4**	**9.1**	**10.0**	**11.0**
SP layer	Meat in Tonnes	648.0	745.0	857.0	986.0	1,134.0	1,304.0
SP broiler	Meat in Tonnes	9,986.0	11,983.0	14,380.0	17,256.0	20,707.0	24,848.0
S/total	Meat in Tonnes	10,634.0	12,729.0	15,237.0	18,241.0	21,840.0	26,152.0
ITFC+CFC	Meat in Tonnes	5,081.0	5,692.0	6,377.0	7,147.0	8,019.0	9,018.0
Total Meat	Meat in Tonnes	15,715.0	18,421.0	21,614.0	25,388.0	29,859.0	35,170.0
SP Layers	Eggs in Million	160.3	184.3	212.0	243.7	280.3	322.3
ITFC+CFC	Eggs in Million	83.4	97.9	115.0	135.4	160.0	190.8
Total Eggs	Eggs in Million	243.7	282.2	327.0	379.1	440.3	513.1

There achievement of the above poultry meat and egg targets was expected to lead to an increase in GDP contribution of 146% from RWF 7.2 billion in 2016/17 to 17.3 billion from the specialized broiler system in 2020/21 and an increase in egg sales to 8.6 billion (a 101% increase) from the specialized layers over the 5-year investment period since 2016/17 until 2021/22 (R-LMP/ ILRI, 2017).

3.2.5 Commercial poultry farming performance

There are no poultry segregated data to indicate the performance of commercial poultry farming. However, considering total poultry farming, there have so far been considerable achievements since 2010. The population of chicken has increased from 3.5 million in 2010 to 5.442,152 million in 2018 showing an increase of 55.5% in the last 8 years, (MINAGRI Report, 2018/2019). Eggs production in MT increased from 5,203 to 7,936 MT while egg consumption increased from 0.47 to 0.63 kg/person/year

Table 3: Poultry population, product and consumption Trends

	2010	2011	2012	2013	2014	2915	2016	2017	2018
Poultry	3,537,608	4,420,764	4,687,984	4,802,764	4,916,837	4,837,794	5,238,497	5,272,725	5,442,152
Eggs in MT	5,203	5,736	6,324	6,757	6,973	7,347	7,347	7,475	7,936
Eggs kg	0.47	0.52	0.57	0.59	0.60	0.61	0.62	0.63	0.63

/pers./year									

MINAGRI, Annual Report 2018/19

Although per capita egg consumption increased, it is still under FAO recommendation of 5.7kg/person/year. In addition, though there has been in increase in the number of poultry numbers, egg production, the achievements are below targets planned in Rwanda, R-LMP/ILRI, 2017. Efforts should therefore be made to achieve the planned targets.

3.2.6 Commercial poultry farming and socio-economic development

There is limited data on the contribution of commercial poultry farming to businesses, society and economic development of Rwanda. However, industry experts, poultry farmers and field assessment indicated poultry farming in general and its value chain in Rwanda has the potential to uplift the socio-economic conditions of poultry farmers, local communities, and businesses hence contributing to national development. This also applies to Commercial poultry farming. It is estimated that commercial poultry farming /specialized broiler system has the potential to contribute to an increase in GDP from RWF 7.2 billion in 2016/17 to 17.3 billion in 2020/21 and eggs from the specialized layers increases to 8.6 billion in 2020/21 from 4.2 billion in 2016/17 over the 5-year investment period (R-LMP/ILRI, 2017).

In terms of contributing to business development, although commercial poultry farming started recently and is still small, it has successfully led to emerging of other businesses such as poultry individual farmers, animal feed producers, poultry products and by products processors, traders, agro-dealers as well as input suppliers such as farmers supplying maize and soya for animal feed production.

These businesses have not only benefited owners but have created jobs employing many Rwandans including women and youths hence contributing to the realization of improved livelihoods and poverty reduction. In addition, government has benefited from such businesses through collecting taxes. Some of these businesses sell their products as exports to DRC hence generating foreign currency to the government.
Overall the above have to the production of goods and services that sustainably foster economic growth and development.

Furthermore, poultry value chain cooperatives and association such as Rwanda Poultry Industry Association (RPIA) have emerged and this helped people to protect themselves against exploitation and unfair business practices. This has given them a voice and power that they would otherwise not have had. Using this association, they lobby for issues affecting the industry, look for markets and negotiate for better prices

Despite the socio-economic role played by poultry value chain, commercial poultry value chain actors working in these poultry value chain still face numerous challenges ranging from unrealizable technological capacity challenges in terms of institutional governance and insufficient skills by members. Specialized commercial chicken production in Rwanda is also constrained by a number of challenges related to feeds, poultry genetics, poultry health, marketing and processing, and weak extension services.

3.2.7 Supply and Demand trends for the poultry products in Rwanda

Poultry term designs domestic fowl, including chickens, ducks, turkeys, and pigeons. However, this section on supply and demand trends for the poultry products focuses on the chickens raised for meat or eggs that represent about 95% of the poultry species in Rwanda.

i) Chicken meat market

On the contrary to pork, where the highest growth potential is in exportation, the poultry subsector depends on the domestic market as indicated below in table 4.

The internal consumption of chicken meat has been growing by 16% per year, on average, from 23,700 tons in 2015 to 42,700 tons in 2019.

At the same time, Chicken meat exports declined from 463 tons exported in 2015 to only 278 tons exported in 2017, before growing again to 351 tons in 2018 and 442 tons in 2019.

Table 2: Chicken meat market (Tons, 2015-2020)

Year	2015	2016	2017	2018	2019
Chicken meat market (Tons)					
Production	24,087	28,904	34,685	37,806	43,099
Import	98	134	67	59	46
Export	463	438	278	351	442
Domestic market	23,722	28,599	34,474	37,514	42,703
Chicken meat trade balance (Tons)					
Trade balance	365	305	211	292	396

Source: MINAGRI Livestock Unit, 2020

The domestic market absorbs 99% of the country's chicken meat production. Attracted by this growing demand, Rwanda chicken meat production increased from 24,100 tons in 2015 to 43,100 tons in 2019, averaging 16% growth per year. Like for pork, Rwanda mostly exports live chicken to DRC. In 2019, the country exported 842,000 live chickens (about 72,200 chicken a month or 2,800 chicken per day).

In terms of value, the domestic market of chicken meat generated £ 141 million in 2019 (Table 5).

Table 3: Chicken meat market value (£, million 2015-2020)

Year	**2015**	**2016**	**2017**	**2018**	**2019**
Chicken meat market value ((£, million)					
Domestic production	39.5	74.8	96.2	88.3	143.3
Import	0.8	1.2	0.9	1.0	0.9

Export	2.7	3.0	2.0	2.5	2.9
Domestic market	37.5	72.9	95.1	86.8	141.3
Chicken meat trade balance (£, million)					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Trade balance	2.0	1.9	1.1	1.5	2.0

Source: MINAGRI /Livestock Unit, 2020

The consumption of chicken meat is rapidly increasing in Rwanda. From £ 37.5 million in 2015, the chicken meat industry generated £ 141 million in the domestic market and about £ 3 million in export earnings in 2019. However, chicken meat exports remain relatively modest. For the last five years, they fluctuated between £ 2 and £ 3 million per year.

Figure 1: Chicken meat production and domestic market (Tons, 2015-2019)

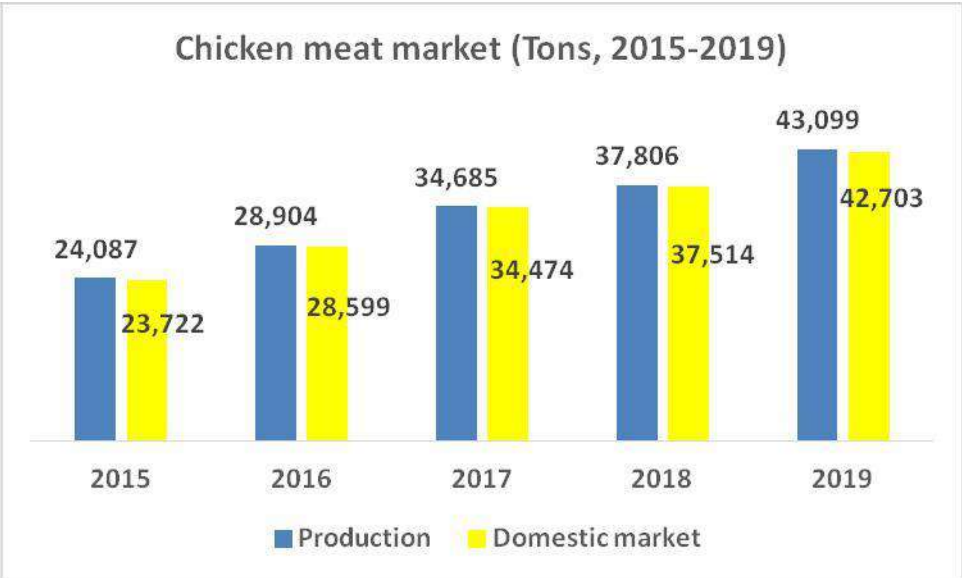
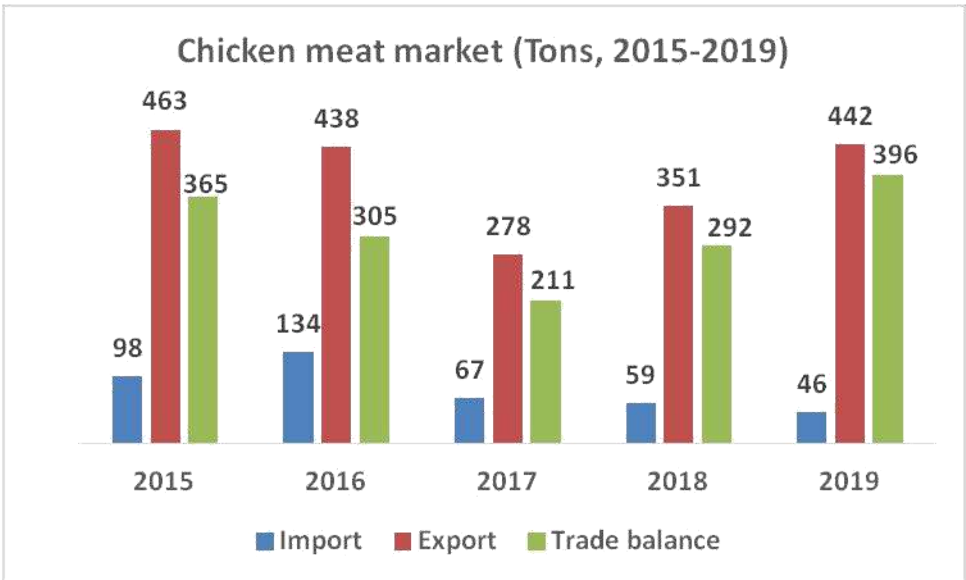


Figure 2: Chicken Import, Export and Trade balance (Tons, 2015-2019)



ii) Egg market

The egg market is relatively stable, noting a likely market saturation. For the last five years, the domestic consumption of eggs fluctuated between 5.800 tons (2015) and 6,900 tons (2017), annually growing by 2%.

On average, the country consumes 6,400 tons of egg per year (about eight eggs per person per year). On the same trend, the egg production remained stable, between 7,400 tons (2015) and about 8,000 tons (2019), averaging 7,600 eggs per year.

Table 4: Egg market (tons, 2015-2020)

Egg market (Tons)					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Production	7,347	7,475	7, 475	7,936	7,972
Import	46	55	10	12	13
Export	1,513	879	615	1,270	1,661
Domestic market	5,880	6,651	6,871	6,678	6,324
Chicken meat trade balance (Tons)					
Trade balance	1,467	824	604	1,258	1,648

Source: MINAGRI /Livestock Unit, 2020

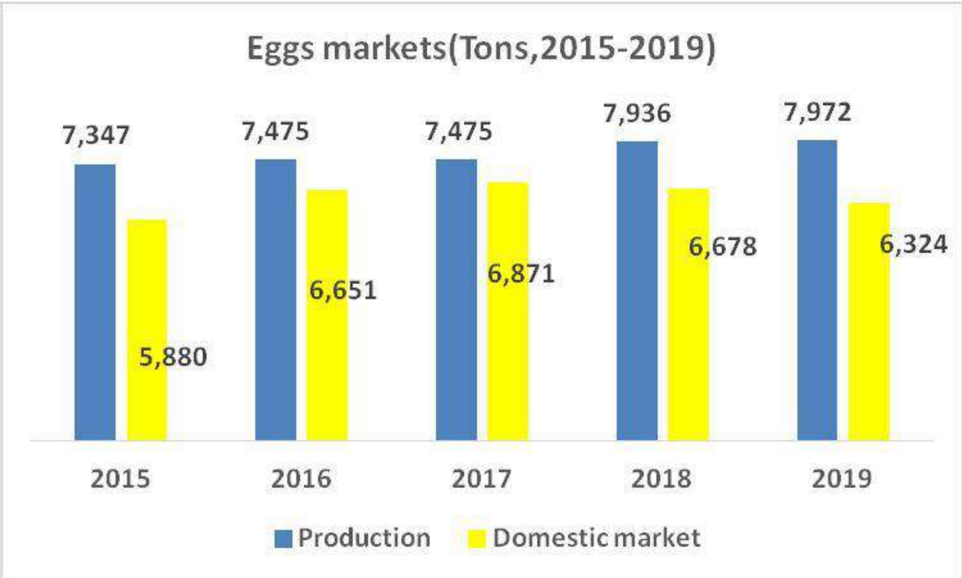
The demand for egg export is also unstable. Egg exports declined from 1,500 tons (2015) to only 600 tons in 2017, before growing again up to about 1,700 tons in 2019.

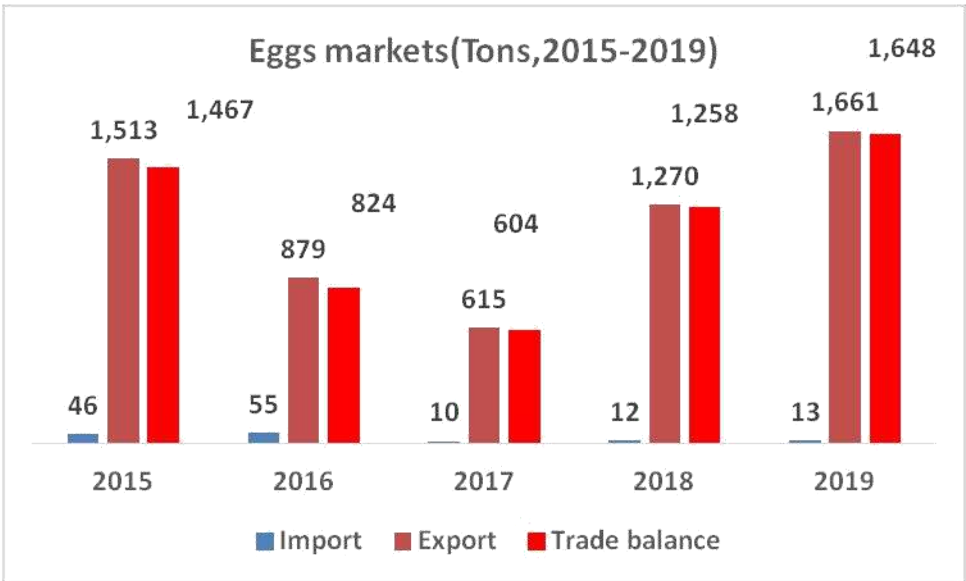
For the last two years, the political tension between Rwanda and Uganda probably prevented Ugandan traders to massively supply eggs to Goma and Bukavu, leaving the space for Rwandan egg production.

For the last five years, the domestic market of the egg has been generating between £ 8.2 and £ 9.6 million per year, averaging £ 9 million annually. The market is slowly growing, with 3% per year on average.

Figure. Egg production and domestic market (Tons, 2015-2019)

Figure 3: Eggs markets, import, export and trade balance (Tons, 2015-2019)





Although the country generated £ 2.2 million in 2015 as egg export earnings, Rwanda's egg exports drastically declined for three consecutive years (2016-2018), making less than £ 700,000 per year. Fortunately, exports increased again in 2019.

Table 5: Egg market value (£, 2015-2020)

Egg market (£, million)					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Domestic production	10.6	8.7	10.0	9.5	11.3
Import	0.3	0.4	0.5	0.8	0.4
Export	2.2	1.0	0.8	1.5	2.4
Domestic market	8.7	8.2	9.6	8.8	9.4
Egg trade balance (£, million)					

Year	2015	2016	2017	2018	2019
Trade balance	1.9	0.6	0.4	0.7	1.9

Source: MINAGRI /Livestock Unit, 2020

Chicken market value

Compared to chicken meat, the egg market seems a limited option. In 2019, the domestic market of egg generated only £9.4 million, where chicken meat was making £141.3 million in the same market. Earnings from egg sales represent only 7% of the chicken meat revenues on the same internal market.

Table 6: Chicken meat and egg market value (£, 2015-2020)

Chicken market (£, million)					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Domestic production	50.1	83.5	106.1	97.8	154.6
Import	1.0	1.6	1.3	1.8	1.4
Export	4.9	4.0	2.8	4.0	5.3
Domestic market	46.2	81.1	104.7	95.6	150.7
Chicken trade balance					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
Trade balance	3.9	2.4	1.5	2.2	3.9

Source: MINAGRI /Livestock Unit, 2020

The total value of chicken products generated £151 million in 2019, from only £46 million generated in 2015. That's a steady growth of 38% per year on average.

Rwanda consumes about 97.5% of its chicken products, exporting for about £ 5 million per year, principally to DRC.

For the last five years, the trade balance remained less than £4 million yearly, and the country registered low performance in the 2016 - 2018 period.

A number of studies have indicated there is a sizeable market for eggs, chicken meat and live birds in Rwanda and in the region. The recent study by Vanguard Economics (2019) estimates the national egg and chicken meat market to be around US$10 Million and US$ 23 Million respectively. The same study indicates that DRC market is largely informal and difficult to estimate. However, Mikhail Miklyaev (2017) estimated that Rwandan national demand for eggs was 13,200 tons (or 203 million eggs) in 2015.

This comprised of 7,500 tons which were locally produced in the country, 7,900 tons imported from Uganda and 2,200 tons exported to the DRC giving Rwanda an annual trade deficit of 5,700 tons of eggs which is equivalent to 43 percent of domestic demand (or 87.7 million eggs).
Although the egg production has increased to 379.1 Million eggs (2018/19) and Ugandan eggs imported reduced to zero, the increase in population, urbanization and welfare of Rwandan that are likely to have increased egg demand even further,

This was confirmed by Focus Group Discussions where farmers reported that there is no problem with market for their eggs. However, the poultry producers claimed to be making little profit margin due to expensive inputs and they risk losing ground to efficient producers in the lucrative export markets of DRC which comprises of 95% of Rwandan exports as indicated below.

Table 7: Volume &Value of eggs imports and exports

	2014	2015	2016	2017	2018
Eggs imports from Uganda (US$)	361,000	424,000	424,000	14,000	0
Eggs imports Other Countries(US$)	31,000	0	152,000	558,000	1,055,000
Total Imports(US$)	**392,000**	**424,000**	**576,000**	**572,000**	**1,055,000**
Eggs exports to DRC (US$)	374,000	417,000	40,000	41,000	68,000
Eggs Emports to Other Countries(US$)	2,000	0	0	0	10,000
Total Exports(US$	**376,000**	**417,000**	**40,000**	**41,000**	**78,000**

Source: Trade Map, International trade statistics

The poultry feed processors cited the over dependence on imports, including ingredients for the local production of poultry feeds, as well as pharmaceutical products as one major constraint that hampers poultry productivity and profitability and this negatively affects supply and demand of poultry products. The availability of poultry vaccines also remains a challenge in rural areas.

The middle and small scale poultry farmers from focus group discussions cited the price of a broiler day-old chicks (DOCs) imported from Belgium (FRW 700 FRW) is far above FRW 600, which is the price of DOCs supplied by the domestic hatcheries. All poultry farmers (large, middle and small scale) contend that the domestic supply of DOCs is often unreliable in terms of quality and farmers are particularly concerned with limited ability to ensure stable and timely supply of DOCs from the local sources. Large poultry farmers indicated that they prefer to pay higher price for better quality and timely availability of Belgium DOCs. The financial analysis of investment in mini-hatcheries has revealed an internal rate of return of 60%, exhibiting current high market price for the DOCs (FRW 700).

The middle and small scale farmers group discussions cited initial investment requirement into building, equipment and parents' stock, constrain. This often affects many operators from construction of standard hatcheries with modern or semi modern technological equipment's that would be more competitive hatcheries.

In addition, many farmers from middle and small categories lack knowledge on the management of parent stock. Increased domestic production of DOCs will drive the price of this critical input down and greatly improve regional competitiveness of the Rwanda poultry value chain. Therefore, any steps to increase/improve technological capacities of private hatcheries through subsidized loans and grants for the domestic supply of DOCs, will be strongly advised. This observation allows to conclude that high 19 market price of DOCs jeopardizes regional competitiveness of chicken meat production. Despite many achievements, the Rwanda poultry sub sector can still be characterized by having limited competitiveness at the domestic or regional levels. Animal feed remains expensive due to the high price of imported ingredients. The availability of poultry vaccines also remains a challenge in rural areas.

3.2.8 Regulatory framework for poultry value chain development under livestock sub-sector

The Government of Rwanda through the Ministry of Agriculture and Animal Resources (MINAGRI) has established legal and regulatory framework for the production, supply, distribution and marketing of animal products and feeds to ensure bio-security and consequently facilitate the trade and distribution of these products in Rwanda, within the region and on the international market.

Achieving poultry production targets and sell poultry products on local, regional and international markets will require Rwanda's products to meet the requisite standards. This in turn requires legal and regulatory systems for the poultry value chain that must pass scrutiny based on international best practices and standards. This study carried a technical audit on the available standards to support the professionalization of the poultry value chain and to see how they are implemented.
Therefore, the following laws, regulations and standards have been enacted to support poultry production, processing, marketing and consumption:

- Law no. 54/2008 of 10/09/2008 determining the prevention and fight against contagious diseases for domestic animals in Rwanda;
- Law no. 003/2018 of 09/02/2018 establishing Rwanda Food and Drugs Authority and determining its mission, organization and functioning;
- Law no. 31/2017 of 25/07/2017 establishing Rwanda Inspectorate, Competition and Consumer Protection Authority and determining its mission, organization and functioning;
- Law no. 33/2002 of 06/11/2002 relating to identification of domestic animals;
- Law no. 56/2013 of 09/08/2013 establishing Rwanda Council of Veterinary Doctors and determining its mission, organization and functioning;
- Organic Law no. 53/2008 of 02/09/2008 Establishing Rwanda Standards Board (RSB) and determining its responsibilities, organization and functioning;
- Ministerial Order no. 013/11.30 of 18/11/2010 on transport and trade of meat;
- Ministerial Order no. 012/11.30 of 18/11/2010 on animal slaughtering, meat inspection;
- Ministerial Order no. 009/11.30 of 18/11/2010 on stray cattle and other domestic animals;
- Ministerial Order no. 008/11.30 of 18/11/2010 determining the organization of veterinary pharmacy practice.
- RS 98: 2015: Animal feed production, processing, storage and distribution — Code of practice
- RS 99: 2017: Compounded poultry feeds — Specification
- RS EAS 231: 2001: Bone meal for compounding animal feed — Specification
- RS EAS 230: 2001: Maize bran as livestock feed — Specification
- AOAC 942.05: Ash of animal feed
- RS CAC/RCP 54: 2009: Code of Practice on Good Animal Feeding
- RS 190:2019 : Water quality – Livestock feeding tolerance limits
- RS EAS 90:2019: Compounded Poultry Feeds

The above laws and regulations are a good step forward in developing agriculture sector and are applicable to the poultry value chain as indicated in the assessment of the legal and standards-framework to support professionalization of poultry, pig and animal feeds VC in Rwanda (MRB Attorneys, 2019). The report however, indicated that some of these laws are inadequate and have gaps in that the laws such as the ones relating to animal slaughtering and meat inspection, as well as transport and trade in meat fall far short of the minimum standards or basic hygiene standards for abattoirs, handling, storage, transportation, disposal and packaging of meat.

The report indicates the following challenges/gaps:

i. Standards are voluntary in nature and can only be enforced if translated into technical regulations enforceable as legislation;
ii. There is very low uptake of standards by the private sector in the country mainly because of the voluntary nature of standards, financial resource constraints, limited knowledge on the importance and value of standards as well as limitations related to enforcement of compliance with standards;
iii. Limited numbers of qualified personnel in the field of standards and technical regulations development;
iv. Other than the challenges and gaps posed by lack of and inadequate legislation, the report found out that Rwanda currently has a sufficient standards framework that can be relied on to further develop and modernize the three poultry value chain. In relation to legislation and institutions. Rwanda can build on the current work by the private and public sectors to intensify production and expand outreach to the private sector involved in the poultry value chain while a prioritized legislative program is initiated to bring the poultry value chain to full compliance with standards and best practices.

To ensure quality assurance as well as modernization of the poultry value chain, this study recommended RAB and NIRDA to put in place enforceable legislations such as infrastructure standards (housing) for poultry farms, standards for breeding centers/hatcheries, processing, storage facilities, transport of poultry products and packaging. Since some of the gaps and challenges mentioned above may not be resolved in the short term, there should be a deliberately phased method employed for eventual compliance and in accordance with minimum compulsory standards set out within the EAC, African Regional Standards Organization (ARSO) and within the International standards organizations (ISO) framework.

3.2.9 An ex-ante bio-economic feasibility plan for investments in poultry value chain with cases studies for broiler and layer commercial farming

The bio-economic model proposed in this study was drawn from expenses engaged by poultry farmers and incomes values generated from selling poultry products.

In a broiler farm with a given population size of broilers, the expenses should take into account the costs for day-old-chicks, feeds, drugs and vaccines, litter, labour, insurance, energy for heating a brooder house, slaughter, depreciation of houses over 10years and depreciation cost of equipment over 5years. The proposed model considers that incomes will be generated from sale of chickens and manure. The following bio-economic indicators gathered on the ground have helped to estimate the farm profitability:

-The farmer keeps a batch of 5000 broilers

-Day-old-chicks cost= 700FRW/unit

-Mortality rate till slaughter age at 45days=5%
- Manure production /cycle=2.5kg/chicken -
Feed intake up to 45days=4kg
-Feed cost=430FRW/kg
-Labour cost=75FRW/bird
-Insurance cost=50FRW/bird
-Slaughter weight at 45days=1.8kg -
Slaughter cost= 100FRW/bird
-Cost per kg of broiler meat=3000FRW -
Drugs and vaccines=100FRw/bird -
Dressing percentage=70%
-Manure production in 2months=2.5kg/bird
The model assists in estimation of broiler farm profitability as indicated below.

Table 8: Estimation of profitability in a 5000 broiler farm

N0	**A. Expenses**	**Unit cost (FRW)**	**Quantity**	**Total cost (FRW)**
	Variable costs			
1	Day-old-chicks cost	700	5000	3500000
2	Feed cost up to slaugher age (45days)	430	20000	8600000
3	Medicines and vaccination cost	100	5000	500000
4	Labour cost	75	5000	375000
5	Slaughter cost	100	4750	475000
6	Litter cost	20	5000	100000
7	Insurance cost	50	5000	250000
	Subtotal			**13800000**
	Fixed costs			
8	House depreciation over 10years	135	5000	675000
9	Equipment depreciation over 5years	235	5000	1175000
	Subtotal			**1850000**
	Total expenses			**15,650,000**
	B. Incomes			
10	Dressed broilers cost	3000	5985	17955000
12	Manure sale (kg)	40	4750	190000
	Total incomes			**18,145,000**
	C. Profit margin (Income-expenses)			**2,495,000**

From table 10 above, the difference between incomes (18,145,000FRW) generated by the farmer and expenses (15,650,000FRW) engaged in operating activities shows a profit margin of 2,495,000 FRW per production cycle of 2months. The study considers that this bio-economic model can be applied to a broiler farmer rearing any given number of broilers for estimating the profit margin in his/or her farm based on the farm records of bio-economic parameters.

In a layer farm with a given population size of birds, this bio-economic model for estimation of profitability is based on farm expenses and incomes like in broiler farm. Expenses should take into account the costs for day-old-chicks, feeds, drugs and vaccines, litter /or cages, labour, insurance, energy for heating a brooder house, depreciation of houses over 10years, depreciation of equipment over 5years. Incomes should be generated from sale of eggs, culled chickens after a production cycle of at least 12months and farm yard manure. The data gathered on the ground gives the bio-economic indicators that can help to estimate the profitability as follows:

1. Farm expenses

a. Variable costs:

-DOCs cost

-Feeds cost (starter, grower,

layer) - Drugs and vaccines costs

- Energy cost for heating

- Fuel/transportation cost

- Labour cost -Insurance

cost

b. Fixed costs:

-Depreciation of house over 10years

-Depreciation of equipment (drinkers, feeders, nests, perchs) over

5years -Interest on bank loans

Total expenses= a +b

2. Farm income

-Sale of eggs

-Sale of culled chickens

-Sale of manure

3. Farm profitability estimation: Incomes-expenses= profit or

loss -A farmer keeps a batch of 5000 layers

-the production cost per a ready pullet to lay is 5000FRW

-the annual egg yield per chicken= 310eggs (ISA Brown breed)

-the monthly mortality rate for layers=0.5% (5000chickens x 12months x 0.5/100= 300dead chickens/batch of 5000layers)

- the annual manure production per chicken=15kg

-Annual feed consumption of layers=43.5kg/bird (standard of daily feed intake=120g/hen)

-Feed cost=370FRW/kg

-Labour cost=400FRW/bird

-Insurance cost=50FRW/bird

- Eggs cost at farm gate=70FRW/unit -

Manure cost=40FRW/kg

-spent (culled) layers cost=3000FRW/unit

Table 9: Estimation of profitability in a 5000 layer farm

N0	A. Expenses	Unit cost (FRW)	Quantity	Total cost (FRW)
	Variable costs			
1	Ready to lay pullet cost, number	5000	5000	25000000
2	Layer feed (20-68weeks), kg	370	204450	75646500
3	Medicines cost	200	4700	940000
4	Labour cost			
	1 Veterinary technician (consultancy service)	50000	12	600000
	2 Permanent workers	50000	24	1200000
5	Fuel/Transportation cost	40	4700	188000
6	Litter cost	20	4700	94000
7	Insurance cost	50	4700	235000
	Subtotal			**103903500**
	Fixed costs			
1	House depreciation	800	4700	3760000
2	Equipment depreciation	1400	4700	6580000
	Subtotal			**10340000**
	Total expenses			**114243500**
	B. Incomes			
1	Eggs sale	70	1457000	101990000
2	Culled layers sale	3000	4700	14100000
3	Manure sale	40	70500	2820000
	Total incomes			**118910000**
	C. Profit margin (Income-expenses)			**4666500**

From the table above, the difference between incomes of 118,910,000 FRW generated by the farmer and expenses of 114,243,500FRW engaged in operating activities shows an annual profit margin of 4,566,500FRW.

To conclude, based on examples taken from selected large poultry farmers, this proposed bio-economic feasibility model can successfully be extrapolated to other poultry value chain actors with regard to estimation of their businesses profitability.

4. FINDINGS OF THE STUDY

4.1 Poultry value chain (PVC) actors in Rwanda

As indicated in the table below, poultry value chain actors include 547 commercial farmers comprising of 74 layer, 372 broiler and 101 dual purpose chickens farmers rearing chickens ranging from large, medium and small scale. Actors also include 14 hatcheries and 16 seed producers, 6 poultry products and by-products processors,19 retailers, 84 poultry input and service providers. These actors are spread throughout the country but with more in Eastern and Western provinces (see Table 12).

Table 10: Mapping of stakeholders of the poultry value chain in Rwanda as per June 2020

Province	District	Broiler Farmers			Layer farmers			Dual-purpose chicken			Hatcheries & Se		ts & By Produ		Poultry Inputs and Services Providers					
		Large	Mediu	Smal	Large	Mediu	Small	Large	Medium	Small	Hatcher	Seed producers	Plant level	Small scale	Agro-dealers	Feed Processors		Transporters	Traders	
																Plants	Small Scale		Whole salers/ Distrib	Retailers
Kigali City	Nyarugenge	0	1	0	1	4	2	0	0	0	0	0	0	0	10	0	0	0	0	3
	Kicukiro	3	2	1	5	3	9	1	1	1	2	2	0	0	3	1	0	1	0	1
	Gasabo	3	2	1	3	5	3	1	0	1	2	2	0	0	0	0	0	2	0	0
Sub-total		**6**	**5**	**2**	**9**	**12**	**14**	**2**	**1**	**2**	**4**	**4**	**0**	**0**	**13**	**1**	**0**	**3**	**0**	**4**
Northern	Gakenke	0	1	6	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Musanze	1	0	4	2	0	7	0	0	0	1	1	0	0	0	1	0	0	0	0
	Burera	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0
	Gicumbi	0	0	0	0	2	0	1	0	1	0	0	0	0	0	0	0	0	1	0
	Rulindo	0	4	0	3	18	0	0	0	1	1	1	0	0	1	0	0	0	0	1
Sub-total		**1**	**5**	**10**	**6**	**21**	**9**	**1**	**0**	**2**	**2**	**2**	**0**	**1**	**1**	**1**	**0**	**0**	**1**	**1**
Eastern	Bugesera	**1**	**5**	**10**	**5**	**29**	**24**	**0**	**2**	**7**	**4**	**4**	**2**	**3**	**26**	**0**	**1**	**1**	**0**	**5**
	Rwamagan	**0**	**5**	**0**	**1**	**20**	**16**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	**1**
	Kayonza	**0**	**0**	**0**	**0**	**6**	**27**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**7**	**0**	**1**	**0**	**0**	**3**
	Ngoma	**0**	**0**	**0**	**0**	**4**	**6**	**0**	**1**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Kirehe	**0**	**0**	**1**	**0**	**4**	**14**	**0**	**1**	**5**	**1**	**4**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**
	Gatsibo	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**22**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Nyagatare	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Sub-total		**1**	**10**	**11**	**6**	**64**	**89**	**0**	**9**	**40**	**5**	**13**	**2**	**3**	**39**	**2**	**2**	**1**	**0**	**9**
Western	Ngororero	0	0	3	0	1	1	0	0	3	0	0	0	0	5	0	0	0	3	0
	Nyabihu	0	0	0	0	4	3	0	1	2	0	0	0	0	1	0	0	0	0	0
	Rubavu	0	0	0	0	10	75	0	0	0	0	0	0	0	1	0	0	0	0	0
	Rutsiro	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	1	0	0
	Karongi	0	0	0	0	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0
	Nyamashe	0	0	2	0	0	4	0	1	0	0	0	0	0	2	0	0	0	0	1
	Rusizi	0	0	1	0	0	4	1	0	6	0	0	0	0	3	0	0	0	0	0
Sub-total		**0**	**0**	**6**	**0**	**18**	**88**	**1**	**3**	**13**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**1**	**3**	**1**
	Kamonyi	1	1	0	1	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Muhanga	0	0	1		0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
	Ruhango	0	1	0	1	5	9	0	0	1	0	0	0	0	0	0	0	0	0	0
	Nyanza	1	0	0	0	0	3	0	0	2	0	0	0	0	4	0	0	0	0	0
	Huye	0	0	0	0	3	2	0	0	0	1	0	0	0	3	1	2	0	0	1
	Nyaruguru	0	0	0	0	0	2	0	8	4	1	0	0	0	0	0	0	0	0	0
	Nyamagab	0	11	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
Sub-total		**2**	**13**	**2**	**2**	**12**	**18**	**2**	**8**	**8**	**2**	**0**	**0**	**0**	**7**	**1**	**2**	**0**	**0**	**1**
Grand Total		**10**	**33**	**31**	**23**	**127**	**218**	**6**	**21**	**65**	**13**	**19**	**2**	**4**	**73**	**5**	**4**	**5**	**4**	**16**

4.2 The current available technology and technological capability

4.2.1 Large Commercial Layer and Broiler Farmers and technologies used

The aspects considered during the audit of technological capabilities of commercial farmers throughout 30 Districts of the country included the general information, farm human resources and skills assessment, poultry farm design, technological capabilities, feeding, management, genetics of chickens, diseases management, farm productions, records, markets and marketing and farm profitability, farm's source of financing and environmental and safety conditions of the poultry farm. The study found the following;

i) Technical ability to adopt and manage the technology

Normally, farmers and their staff play a critical role in looking after the birds and maximizing productivity. The people responsible for the care of poultry should be well trained, experienced and dedicated.

In this regard, the study has shown that owners of large commercial poultry farmers are highly educated and experienced. They also employ technicians with average level of education. 43.7% of large poultry commercial farmers have a working experience of 8 to 24 years, 41.4% have an experience ranging from 5 to 7 years, and 13.7% have a working experience of 1 to 4years.

Farmers engaged in large scale poultry farming in Rwanda are dominated by highly educated people with a bachelor, master or PhD degree at a proportion of 63%. Farmers who completed primary education come at second position with 22.2% and those who completed secondary education represent 14.8%.

The sole proprietorship which represented 75.9% was the most dominant legal status among large scale farmers followed by 17.2% of farmers limited by shares.

Out of 31 large poultry farms interviewed, 30 farms (96.7%) do have local private ownership shares and only one farm (4.3%) consists of foreign ownership shares.

As far as people employment in large farms was concerned, farms who employed between 4 to 30 employees represented 67.7% and between 1 to 3 employees represented 19.4%. Some farms (6.5%) employed between 31to100 employees while others (6.5%) employed beyond 100 employees.

With regard to gender and age ratio among 52 employees in the farms, 55.8% are males while 44.2% are females. The ratio of youth to adult is 4: 1 showing a high level of employment of young workers compared to adult workers.

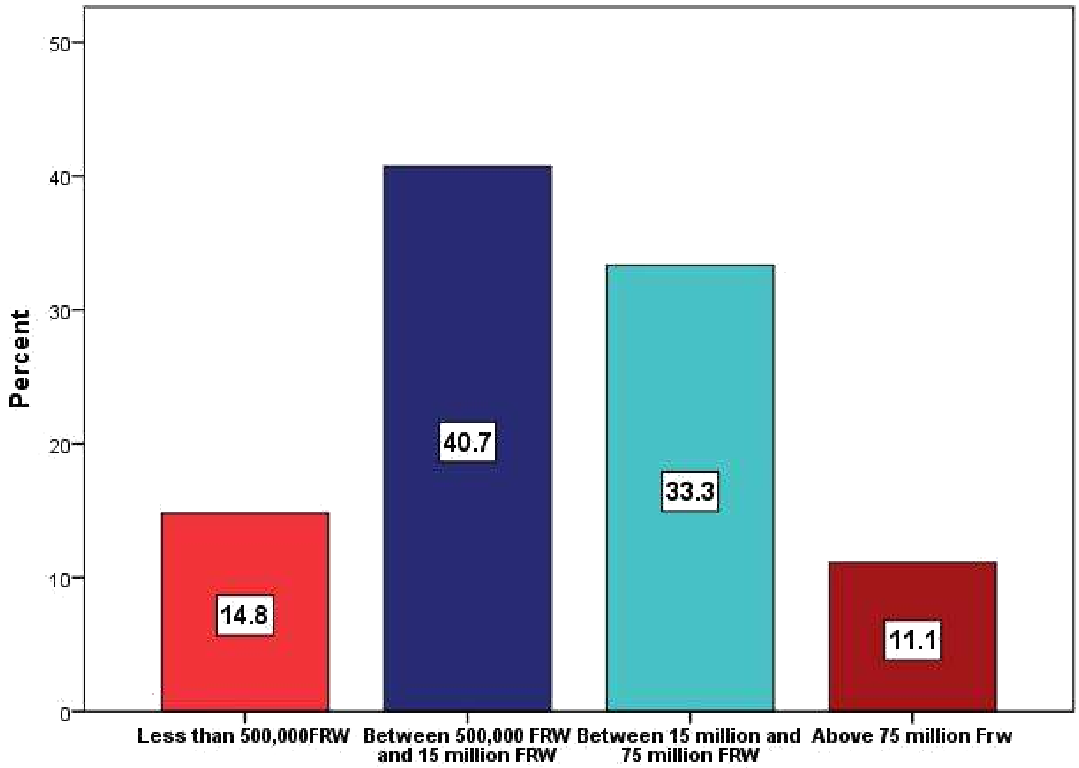
90% of large scale poultry famers reported to having enough land space for production and the ability to extend in the long run. In this regard, 27 farmers representing 87.1% operate on their own land while 3 farmers representing 9.7% operate on rented land.

Table 11: Distribution of commercial poultry farmers in Rwanda

Province	**Large(above 5000 chickens)**
Kigali City	17
Southern	4
Western	1
Northern	7
Eastern	7
Total	**36**

The study revealed that commercial poultry farmers in Rwanda started their businesses with an initial capital of between 500,000 FRW to over 75Million FRW. Of these 40.7%, started with a capital of less than 500,000FRW, 14.8%, with 15 Million FRW, 33.3% with 75 Million FRW, 11% of farmers with more 75Million Frw. Below is a figure representation of this.

Figure 4: Source of initial capital among large scale farmers



Of the above initial capital, 80.3% was contributed by the farmer, 10.4% was a bank loan and 9.3% was family/other shareholders' contribution.

Most of the commercial poultry farmers claimed to use books for accounting but a small do not use them due to low knowledge and skills for filling them. However, they said that elementary information is recorded.

Poultry farmers reported to have experienced many obstacles following the establishment of farms. The obstacles included but not limited to poor cash flow management reported by 48.4%, poor record keeping experienced by 45.2%, Inadequate technology by 41.9%, poor communication by 32.3%, company organization by 25.8%, financial constraints by 25.8%, poor monitoring and control by 25.8% and others by 25.8% such as poultry diseases, lack of drugs, high cost of feeds, low skills in poultry farming, lack of advisers in poultry farming, and lack of clients for poultry products.

ii) Poultry housing system and environment control

The study found out that commercial poultry farmers use different poultry housing systems. It was noted that most large scale poultry farmers use deep litter housing system comprising of 105 poultry houses out of 236 houses (see figure). Only 5 poultry houses apply cage system as shown in the figure below. Others use one tier house (72), mixed system (33), two tier house (21) and cage system (5). Of these 113 housing system were constructed using modern materials while 16 used traditional materials. The house cannot control and therefore temperature and humidity fluctuates with weather conditions.

Table 12: Adoption of poultry housing system technologies by large farmers

Housing system	Number of houses/system
Deep litter	105
Cage system	5
Mixed system	33
One tier house	72
Two tiers house	21
Total	**236**

From the study, it was found out the deep litter poultry housing system is the most commonly used system by all categories of farmers. This housing system is regarded as more economical and the litter materials such as saw dust, wood shavings etc are easily sourced. However, this system has a number of disadvantages which constrains profitability and these include:

It is almost impossible to detect unproductive birds in deep litter;

Deep litter promotes wastage of feeds;

It is associated with a number of diseases ;

It dartens the eggs and it is stressful packing litter often and on to avoid smell, and

Egg breakages are high thus reducing the farmers’ revenue.

Figure 5: Broiler farm with a deep litter system

The study found out that only 5 poultry houses apply cage system and this housing system saves a lot of space, feed wastages is reduced unlike the deep litter system has better advantages compared to deep litter.

Cage system has the following advantages:

- The battery cage saves spaces
- Improvement in performance when compared with birds raised in deep litter system
- It is easy to identify unproducing birds
- Large number of birds is reread per unit
- Cannibalism and egg eating are reduced to the minimum

Figure 6: chicken battery cage system

From the desk review and case studies from countries like The Netherlands and Belgium, the best required poultry house design comprises the following housing standards:

- Poultry houses with different ages of chickens should be as far apart from each other as possible to prevent transmission of disease agents. A minimum of 30 meters between houses with different ages is suggested.
- The farm should be fenced to prevent entry of unauthorized people and other animals such as dogs, cats, backyard chickens, etc. An entryway for people and vehicles must be designed so proper decontamination procedures can be practiced.
- It is suggested to cull sick and injured chickens in the houses and avoid use of hospital or quarantine pens.

There should be a single entry point onto the farm which is equipped with disinfection equipment for all vehicles, people and equipment that are brought onto the premises. Access to the poultry houses must be through a compulsory compartment where cleaning and disinfection can be conducted. Dead chickens on the farm must be disposed of daily in an appropriate manner.

The floor of the poultry houses should be sloped so rainwater and waste water can be directed away from the houses to prevent stagnant water and to prevent recontamination.

Feed storage site should be designed and maintained so to provide good conditions.

Control of temperature, humidity, ventilation and sanitation are critical to ensure quality feed is fed to the birds. Materials used for the construction of poultry houses must be resistant and easy to clean and disinfect. Selection of material must take into account the local climatic conditions.

Therefore it is recommended that most poultry farmers should apply the above poultry housing systems in order to prevent diseases and reduce mortality levels as well as increasing competitiveness of poultry products.

It was found that 92.6% of farmers comply with the stocking density of 7-10 broilers/m^2 and 5 layers/m^2, 88.9% of farmers make use of sufficient natural lighting of their houses with windows representing 1/10 of the house floor space, 96.3% of farmers practice adequate aeration in their houses comprising windows equipped with wire mesh, 87.5% of farmers keep chickens on deep litter system with at least 5kg of saw dust or other bedding material /m^2, 61.9% of cages used for keeping chickens are well-designed, 92.3% of farmers set up a pit for waste disposal. The stocking density looks acceptable and this prevents chicken from pecking and promotes efficiency and productivity.

The sources of electricity and water used in poultry houses for lighting and watering were accessed from public institutions, EUCL and WASAC, in proportions of 74.2 and 80.6% of total large farmers respectively. The level of electricity and water application looks promising to most large farmers and this good prerequisite for promoting advanced technologies in future.

iii) Bio-security measures

The study wanted to ascertain the bio-security measures applied by poultry particularly on what they do to keep diseases from entering a poultry farm. Poultry bio-security is based on two fundamental principles: first, preventing the introduction of a disease agent onto a farm- referred to as 'bio-exclusion' and second, the prevention of the spread of a disease agent on a farm- referred to as 'bioconfinement'. The study indicated that 96% of large farmers apply appropriate bio-security measures to appreciable levels. These include: regular cleaning of house and equipment, wear of personal protective equipment for farm employees, use of a bath room, and a set-up of water tank for rainwater harvesting from the roof among others. They argued that these measures have contributed to prevent poultry diseases.

iv) Feeding and watering system technology

The study found out that the technology of in-house water and feed supply to chickens is manual (57% manual watering while 75% manual feeding for large farmers). However, the study noted that 39% of large farmer apply semi-automatic/or automatic water supply while 23% apply semi-automatic/or automatic system for feeding. The advantages' of automatic watering and feeding systems are cost effective in terms of labour and more efficient in terms of poultry production. Poultry farmers argued that the automatic systems are very expensive and they are highly recommended in order to promote competitiveness of Rwandan poultry products. Framers should be supported through 4 PPPPs policy to acquire investment capital to procure such equipments.

Figure 7: Manual method of feed distribution

v) Product handling technology

The study found out that 80% of large farmers use the traditional ways of hand picking and packaging of eggs in trays and sometimes in cartons. Only 7% use semi-automatic collection of eggs from poultry houses in cage system. Similarly 39% of farmers apply manual system of slaughtering chickens while 3% use appropriate machines for slaughtering. It was indicated that 58% sell un-slaughtered/undressed to their customers' both (broilers and culled layers). The study found out that traditional slaughter system by poultry actors does apply domestic, regional nor international poultry product handling standards. Besides, even the available domestic standards are not well enforced. The study recommends RAB to strengthen the laws and regulations of product handling standards and also ensure appropriate enforcement mechanisms in order to promote competitiveness' of Rwandan poultry products to regional and international export markets.

vi) Heating of brooding house

With regard to the heating of brooding houses, (77%) of large scale farmers use traditional brooders made up of used pots, charcoal stoves and only 21% of farmers use modern brooders such as radiant or infrared lamps. It should be noted that warm litter or bedding material on the floor is critical to helping the baby chick maintain its body temperature the first few days after hatch. Ideally, and from case studies from the developed countries, radiant heaters have become the preferred method of providing heat during brooding because they provide a range of thermal comfort options for chicks and have been to shown to be cost effective to operate. As indicated in the study most farmers use traditional brooders made up of used pots, charcoal stoves and this system does not control appropriate temperatures leading to poor quality chickens. The study recommends radiant heaters because they do a much better in temperature regulation and this would help competitiveness of Rwandan chicken to export markets.

viii) Debeaking technology

The technology of debeaking is very important in prevention of cannibalism among chickens and the study found out that 68% of large farmers apply debeaking while 32% of them don't apply debeaking at all and thus affects chicken leading to mortality challenges and less production. Poultry farmers normally use different means including debeaking machine, scissors and red hot iron.

ix) Waste management technology

The study found out that 100% of large farmers apply manual system of waste disposal using shovels. The technology of removing animal waste using appropriate equipment such as transporting belt is absent in poultry farming in Rwanda. Farmers sell farm waste as composite manure to farmers at a range of 25 to 40 frw per kg. In order to increase poultry farm profitability, there is a need to conduct a research on how to add value to the poultry farm waste with the aim to transform into composite manure.

x) Nature of poultry feeds

In regard to poultry feeding, 71% of large farmers' source feeds from feed processors while 29% of them use homemade feeds prepared at farm level and they claim that this approach is relatively cheaper. The study found out that all farmers (large, middle and small) indicated challenges of scarcity of poultry feeds as well as the quality of the feeds. Feed processors indicated the scarcity of the feeds is due to low supply of feed ingredients besides most of these ingredients are imported.

The Government of Rwanda implemented the policy of waiver of taxes including VAT chargeable on animal feeds input and other related ingredients but this has not fully resolved the low supply of feed ingredients'. Thus more interventions will be necessary to make Rwandan feeds more competitive on the market oriented.

It is important to note that animal feeds inputs such as maize/corn, fishmeal, soy beans, cotton seed meal, sunflower meal and premixes being not readily available on the Rwandan market and this makes animal (poultry) feeds not only costly in real terms but also lack the benefits of economies of scale for producers leading to high prices. Furthermore, the bulk of these inputs into animal feeds are also consumed by human beings thus creating another angle of competition with the production of human food thereby further accentuating the price increase.

Availability of sufficient animal feeds is crucial for the development of the poultry industry in Rwanda. It is important to look at different options and alternative mechanisms for domestic feed ingredients' supply production and or access to feeds that would improve the sector while Rwandan poultry production remains cost effective and competitive in the market.

Focus group discussions indicated the poor quality of feeds and this could be poor compliance to processing standards. The study recommends RSB to ensure processing compliance as well as enforcement mechanisms.

xii) Types and Sources of Day-Old- Chicks

The groups and genetics of commercial chickens reared by commercial farmers in the country are broilers, layers and dual-purpose chickens. There are several breeds under each of the three groups such as (ISA Brown, Bovans Brown, Cobb 500, SASSO and Kuroiler...).

The main source of the Day-old-chicks (DOCs) for chickens reared in Rwanda is from domestic hatcheries such as Uzima chicken, Easy Hatch while other are imported from regional and international markets such as Netherlands, Belgium, Turkey, Germany and India.

The unit cost for broiler DOCs purchased by farmers' ranges between 600 and 700FRW while it fluctuates between 1150 and 1200FRw for layer DOCs. The table below gives a list of poultry inputs like brooders, cages, DOCs, drugs, feeds, feeders, drinkers and their sources.

XII. Diseases management

-Vaccination and medication programmes

The study indicated that commercial poultry farmers are aware of the existence of poultry diseases, vaccinations and management of their chickens thanks to RAB extension services and advocacy. In addition, farmers also apply a medication and sanitization programme comprising of antibiotics, coccidiostats, antiparisitics, antistress drugs and disinfectants.

The study found out that these medicines and vaccines are irregularly distributed and sometimes are scarce. Very often agro dealers are not aware or knowledgeable of some new diseases and vaccines, drugs and the way they are administered. There is a need to conduct specialized trainings for agro dealers because they are in better position to provide technical services to farmers.

- Poultry eextension and veterinary services

The availability of the extension and veterinary services to poultry farmers is at a rate of 67% and 69% respectively. The main providers of these services include MINAGRI/RAB staff, District animal resources officer-DAROs and the sector animal resources officer-SARO), private veterinarians, input supplying companies' development partners such as NGOs among others.

The study established unreliability of public veterinary services resulting from the fact that DAROs/SAROs are overwhelmed with so many activities and serving many clients and a result most commercial poultry farmers resort to private veterinary service providers. The study indicated that the private extension and veterinary service provides are few and expensive. They are also reported to lack adequate stock of essential drugs and certain specialized technical skills such as disease diagnosis and control.

The study recommends MINAGRI/RAB to strengthen the capacity of Rwanda Council of veterinary doctors (RCVD) to continuously provide quality, affordable and reliable veterinary services for poultry farmers particularly rural based farmers.RAB should set up a coordination mechanism for both private and public extension and veterinary service providers with the main objective of to continuously provide quality, affordable and reliable veterinary services to poultry farmers particularly rural based farmers.

XIII. Farm management and records keeping

The study found out that (72%) of large poultry farmers often kept their farm records. Most of the records kept include: Animal feed intake, Vaccination and treatment records, slaughter age, length of production cycle, mortality rate, and monthly financial records among others.

4.2.2 Poultry Products and By-products Processors

The study found out that there are six poultry product processing companies. Two of the processors' have fully equipped machines while four other are technologically under equipped. The study shows that processors source chickens from farmers, traders or from own farms. Most of processors operate at small scale with a processing capacity ranging from 80 to 1,000 chickens /day, except PEAL Ltd and ABUSOL Ltd that use machines with a high processing capacity of about 700 chickens /hour and 1500 chickens/hour respectively.

Products from processing vary from whole chicken carcass to chicken meat cuts (fresh and frozen) including necks, wings, fillets, legs, drumsticks, breasts, thighs and offals consisting of gizzards, hearts and livers. Other products like sausages, burgers, smoked poultry; nuggets (fresh and frozen) are only being produced by ABUSOL Ltd.

By products of processing identified among processors comprise: feet, heads, intestines, feathers, blood, abdominal fat, crop, trachea, some of them are sold as animal feeds to farmers while other are disposed in waste management pit. The target markets for poultry processors comprise local market, bars, restaurants, food shops (supermarkets), specialized poultry outlets and hotels.

Target markets for by products are: Pig farms, rendering plant to produce dry powder for animal feed, Bio digester plants to produce electricity.

Technological challenges identified by the study are related to the lack of investment capital for small scale processors to acquire processing machines that are leveled to the capacity of PEAL and ABUSOL Ltd companies and appropriate means of transport equipped with a cold system for delivering to markets (consumers) good quality products.

Small scale poultry processors reported the challenge of lacking capital to acquire appropriate machines for processing in order to improve the meat quality. They indicated that most of their products cannot meet export market standards due to poor quality processing machines as well as weak enforcement of meat processing regulatory standards. In order to compete favorably, poultry products processors need to acquire appropriate processing machines. There is a need also to raise awareness on regulatory processing standards that are enforceable.

Another challenge reported by large and small scale processors is existence of the informal/illegal backyard poultry slaughtering and this denies the supply of live chicken to formal processing companies leading to low processing capacity of large companies and this the competitiveness of Rwandan poultry products to export (regional and international) markets.

4.2.3 Focus Group discussion and finding with Poultry Inputs and Services Providers including medium & small scale farmers

This group of value chain actors comprised of transporters of poultry products, agro-dealers selling poultry inputs and equipment and provide veterinary services, poultry feed processors and poultry traders including wholesalers/distributors and retailers as well as medium and small scale farmers. This group of the poultry value chain stakeholders was organized into FGDs drawn from the provinces as indicated below (Table13).

Table 13: Numbers of Participants in Focus Group Discussions per Province as per June, 2020

Province	Medium Poultry farmers	Small Poultry farmers	Trans porters	Agro-dealers	Feed processors	Retailers/ Wholesalers	Total
Northern	11	15	2	1	1	1	30
Eastern	41	39	1	26	3	4	111
Southern	19	22	0	7	2	0	49
City of Kigali	7	6	2	9	0	1	27
Western	14	35	1	11	0	5	65
Total	**92**	**117**	**6**	**54**	**6**	**11**	**282**

Results from the discussion provided more inputs into SWOT analysis discussed in the sub-sector in 4.2.3. The call conference method was used instead of face to face to gather information because COVID-19 pandemic challenges. The following table 14 is a summary from the Focus Group Discussions.

Discussions focused on level of application of technology in poultry value chain, types/services received, sourcing of basic inputs, marketing and dealing with competitors, business profitability, constraints, environmental management, partnership with service providers and employees skills development . Interview guide for FGDs members is attached in Annex 4.

Table 14: Technological levels among selected PVC actors (FGDs members), constraints and proposed interventions

Category	Level of technology application	Issues/constraints	Proposed interventions/recommendations
Small farmers	FGD indicated that generally Poultry houses do not meet appropriate poultry housing standards. 50% of those interviewed in FGDs indicated that the use of solar panel to generate energy for lighting.	Poultry houses lack clean water and electricity, (usually use lanterns), no proper feeding and watering system and usually use charcoal for heating the brooder house for chicks. They indicated that water is a big challenge.	RAB should set up standards and requirements for construction of poultry houses suitable for (large, medium and small scale farmers) that would promote competitiveness’.

Source DOCs from domestic butcheries with very few sourcing from international markets through agro dealers.	Small scale farmers argued that internationally sourced DOCS are expensive and supply is unreliable and takes long times in terms of procurement. Domestically procured DOCs are often of poor quality. They claimed quality is associated with lack of parent stock or even poor management of the existing local hatcheries.	Since the quality of DOCs in Rwanda is a national concern, public (RAB) and private sector should collaborate and jointly set up a poultry Center of Excellency that meets international standards.
Poultry feeding is not adequate and do not respect feeding standards of chickens. Due to the expensive nature of the industrial feeds small farmers prefer to use own farm mixed feeds which do not meet appropriate feeding standards.	Industrial feeds are costly compared to homemade feeds. There is weak purchasing power and high transport cost. Lack of knowledge on which feeds to use and poor feed quality of available feeds.	The study recommends contract farming system between feed processors and poultry feed ingredient growers and suppliers in order to solve the problem of imported ingredients. Feed processors should establish large scale stocking system that would accommodate during harvest time. RSB should enforce the existing poultry feed processing standards Feed processors and feed distributors (agro dealers) should be supported quality and timely services to poultry farmers.

	Small poultry farmers contend the poor management of Chickens health management due to lack of specialized skills in poultry health management.	Lack of poultry specialized skills in healthy management.	RAB in partnership with RPIA should set up a capacity building mechanism for strengthening technical capacity of poultry farmers (large, medium and small scale) and their employees with regard to diseases control management.
	Both medium and small scale like large farmers applies manual system of waste disposal using shovels. The technology of removing animal waste using appropriate equipment such as transporting belt is absent in poultry farming in Rwanda. Farmers sell farm waste as composite manure to farmers at a range of 25 to 40 frw per kg. In order to increase poultry farm profitability, there is a need to conduct a research on how to add value to the poultry farm waste with the aim to transform into composite manure.	Collection and sorting of poultry waste is done manually without appropriate protective equipments such as gloves and boots.	Farmers to acquire PPE for farm employees RAB and RPIA should raise awareness so that can comply with personal health standards. To process poultry farm manure into more valuable composite manure for increase of farm profitability.
	The most common source of poultry farmer's extension and veterinary services are from both public and private sectors. Public include: MINAGRI/RAB, DAROs and SAROs while Private includes: agro dealers, private	The keys issues identified include accessibility and availability of public practitioners, Private are accessible but are very expensive. Essential drugs/vaccines are costly and sometimes	The study recommends MINAGRI/RAB to strengthen the capacity of Rwanda Council of veterinary doctors (RCVD) to continuously provide quality, affordable and reliable veterinary services for poultry farmers' particularly rural based farmers. RAB should set up a coordination mechanism for

	veterinary practitioners and development partners. It was noted that most Most farmers in FGDs indicated that farmers preferred private veterinary technicians but argued that they are often very expensive. Public personnel availability is a challenge.	not available.	both private and public extension and veterinary service providers with the main objective of to continuously provide quality, affordable and reliable veterinary services to poultry farmers particularly rural based farmers.
Medium Farmers	Moderately adequate house fulfilling standard requirements with electricity and sometimes chickens kept in cages for increasing egg production	Production cost of basic infrastructure such as electricity and water is high.	RAB should set up standards and requirements for construction of poultry houses suitable for (large, medium and small scale farmers) that would promote competitiveness'.
	As noted with small scale farmer, the most common source of poultry farmer's extension and veterinary services for medium scale are from both public and private sectors. Public include: MINAGRI/RAB, DAROs and SAROs while Private includes: agro dealers, private veterinary practitioners and development partners. It was noted that most Most farmers in FGDs indicated that farmers preferred private veterinary technicians but argued that they are often very	The keys issues identified include accessibility and availability of public practitioners, Private are accessible but are very expensive. Essential drugs/vaccines are costly and sometimes not available.	The study recommends MINAGRI/RAB to strengthen the capacity of Rwanda Council of veterinary doctors (RCVD) to continuously provide quality, affordable and reliable veterinary services for poultry farmers' particularly rural based farmers. RAB should set up a coordination mechanism for both private and public extension and veterinary service providers with the main objective of to continuously provide quality, affordable and reliable veterinary services to poultry farmers particularly rural based farmers.

	expensive. Public personnel availability is a challenge.		
Transporters	FGDs indicated that poultry products transport (eggs, meat and live chickens) transportation systems are associated with significant pre-harvest losses due to inadequate handling and transport facilities/equipments and notable among them are: inappropriate vehicles, motorcycles, bicycles and sometimes human head. The above mode of transport systems does not have temperature controlling system such as coolers. The mode of transport is aggravated by poor road infrastructure often resulting in long hours on the road. It should be noted that in appropriate technology requires appropriate storage facilities and a transport mode equipped with appropriate cold system. Transporters source poultry products from farmers and processors. The handling facilities comprise containers	The business is too small to need a specialized transport. The main poultry product transport challenges reported by transporters in FGDs are: Lack of capital to acquire appropriate vehicles equipped with a cooling system for transport. Lack of knowledge and awareness on transport of poultry products regulatory standards.	RAB should enforce licensing of carrier vehicles with appropriate cooling system for poultry products that meet regulatory standards.

	(baskets), egg trays, cartons and bags. The packaging materials consist of eggs trays, biodegradable envelopes, and plastic envelopes.		
Agro-dealers	Poultry agro-dealers are part of PVC actors and their role is to: To sell poultry drugs, vaccines, feed to farmers and poultry equipments. Provide elementary advisory services to farmers on good farming practices. They are distributed all over the country up to sector level.	Agro dealers argued that drugs, vaccines, feed to farmers and poultry equipments are purchased at higher prices sometimes not affordable to their clients –farmers. There is also a general lack of essential drugs and vaccines which are always on high demand by farmers and this affects the health of poultry leading to less competitiveness.	Capacity building through acquisition of technical capacity or strengthening existing capacity.

4.2.4 Hatcheries and seed producers

i) Mapping hatcheries and seed producers

A total of 14 hatcheries operating countrywide were identified as indicated in table below. Besides hatcheries, the study identified seed producers that are in charge of buying DOCs from hatcheries, rearing them until the age of pullets or starters (of approximately 60days) ready for selling to farmers.

Table 15: Distribution of hatcheries and seed producers in Rwanda as per June 2020

Province	Number of hatcheries	Number of seed producers
Kigali City	4	2
Southern	3	2
Eastern	5	1o

Northern	2	2
Western	0	0
Total	**14**	**16**

ii) Demand and supply of day-old-chicks

The study shows that there is a positive evolution in production and supply of day-old chicks (DOC) in which local production is gradually substituting imports from the region (Kenya and Uganda) or international (Netherlands, India, Turkey and Belgium) at a significant cost.
The poultry Study, (USAID 2016) shows that in 2010, 398,552 DOCs were produced locally and 1,087,390 were imported, yet by 2015 local production had more than doubled to 912,000 DOC while imports had reduced to 870,000 chicks.

This study also shows that there has been positive trends in domestic production of DOCs compared to imports refer to the tables 16 and 17 below. In 2019 for example domestic DOCs production stood at 19,033,497 compared to 757,479 Imports.

Rwanda currently has two big companies that produce day-old chicks (Uzima chicken Ltd, Easy Hatch Ltd). The two companies meet only 15% of the domestic demand. The vast majority of poultry farmers import the DOCs from the Netherlands, Belgium, Uganda (layers), and Mauritius (broilers). Agrotech Ltd is the leading DOCs importer.

75.5% of hatcheries use national electricity grid as the main source of energy while 18.8% use solar energy and 6.3% use other sources like generators. Owners of hatcheries reported that the initial capital investment to establish the hatcheries was ranging between 30millionFRW and above 75MFRW. 61.54% of them started with 30 and 50million FRW, 20.08% and above 75million FRW for 15.38% of hatcheries owners. Hatcheries were found to use various books for accounting including cash book, journal, ledger, sales book, balance sheet, inventory, profit and loss, creditor book and debtor book.

Table 16: Production of day-old chicks in Rwanda, 2017-19

Year	**2017**	**2018**	**2019**
Domestic DOCs production (heads)	1,384,790	1,556,271	19,033,497

Table 17: Import of day-old chicks to Rwanda, 2017-19

Year	**2017**	**2018**	**2019**
Day-Old-Chicks (heads)	811,746	784,143	757,479

From the study it was found out that there is a positive trend in the production of domestic produced DOCs. The demand is also higher than the supply of DOCs.

The unit cost for domestic broiler DOCs purchased by farmers' ranges between 600 and 700FRW and domestic layer is 1000 FRW while imported broiler DOCs is 850 FRW and imported Layer DOCs cost 1200 FRW

Poultry farmers indicated that domestic produced DOCS are relatively cheaper compared to the imported DOCs however, farmers complained of the quality of domestic produced DOCS

iii) Challenges facing hatcheries

When asked the cause of the poor quality of DOCs, hatchery companies indicated the poor quality is due to lack of parent stock and where the parent stock is available there were issues of poor management of the parent stock in terms of breeding, feeding and disease management and control.

Other challenges identified include:

i. Low capacity of incubators;

ii. Poor capacity to meet farmers demands;

iii. Hatchery companies without parent stock relay on imported fertilized eggs.

iv. Inadequate technical skills and financial capacity.

The study recommends the establishment of breeding Centers or Center of Excellence in each province that is competitive and meets regulatory international standards. In order to achieve this it would be better to apply 4Ps principle. This 4Ps model involves public, private and producer partnership. The public, private and producer partnership (4Ps) model is a project financing model which allows poultry value chain to be financed jointly by several actors involved in PVC, namely the private who buys and sells the production, the poultry farmer and the public sector which supports the value chain of that production. 4Ps model allows putting in place all necessary measures to control and making a close follow up of each step of investment, and render the beneficiary more accountable to the use of grant. That model facilitates in financing individuals, companies, cooperatives, and even joint business between individuals or companies with cooperatives.

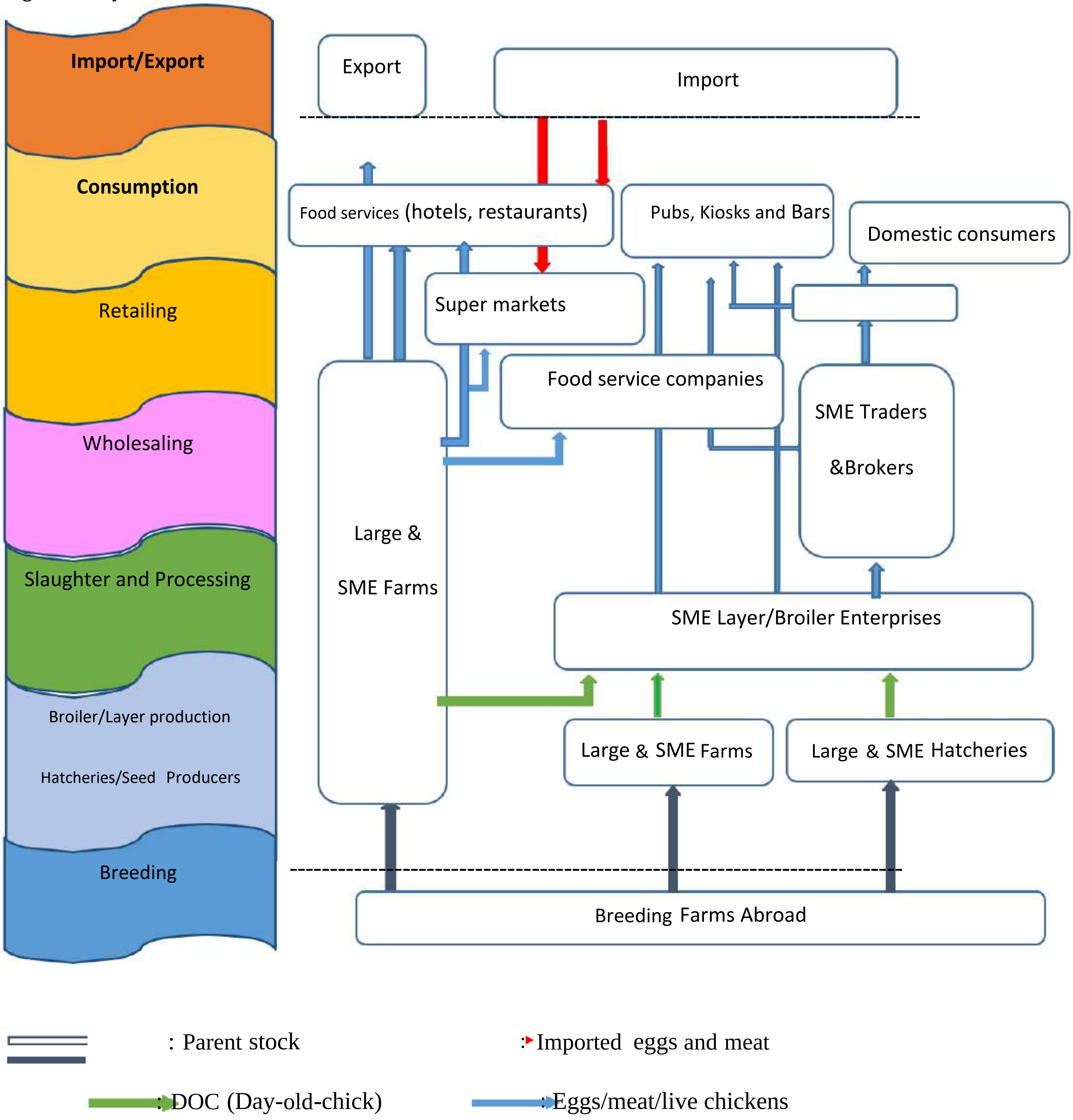
4.2.5 Poultry products marketing systems

The study findings from both large and middle scale farmers indicated noticed growing domestic and regional markets for poultry meat and eggs and this has spurred investment in the poultry layers by many farmers.

Eggs and broilers are produced by small, medium and large poultry farmers, with the majority of output purchased by small traders for delivery to city outlets (wholesalers, exporters and retailers). In addition to domestically produced poultry products, wholesalers also supply retailers with imported eggs and/or broilers. Retailers supply eggs and broilers to hotels, bakeries, street vendors, fast food chains, restaurants and households throughout the country.

Some poultry farmers deliver eggs directly to retail outlets. Some large-scale farmers operate slaughtering houses, delivering broilers directly to retail outlets. Spent layers, the meat of which is of poorer quality, are distributed through the same market channels. The Rwandan market for poultry products is dominated by exotic-breed eggs and broilers. A small quantity of indigenous eggs and hens are sold directly to consumers at rural weekly markets, or through middlemen known as collectors. Collectors sell to travelers along the highway to Kigali, DRC and in recent past to Burundi, or to food outlets and residents in neighboring urban areas. In this supply chain, these poultry products are transported by ordinary vehicles, motorcycles, and bicycles or even carried by hand and there is no use of specialized transport means/containers. This affects the quality of poultry products but sometimes heavy losses due to breakages resulting carrying eggs in baskets.

Figure 8: Layer and broiler value chain in Rwanda



According to focus group discussion by medium and small scale farmers, consumers prefer large egg with yellow yolks, with some requesting details of origin. The majority of eggs and broilers are sold on domestic markets, in rural villages, cities and Kigali. The bulk of poultry-product exports are marketed in the Kivu provinces of the DRC, accessed via Western province border crossings in Rwanda's Rubavu and Rusizi districts. A small proportion of exports also used to cross in Burundi. The main competition to Rwandan eggs' export used to comes from Uganda. Both the domestic and regional markets for poultry show signs of steady expansion, spurred by population growth, increasing urbanization and associated changes in diet.

The study findings from 70% of the large scale poultry farmers indicated that the medium- to high income urban residents of Kigali and the wider region are increasingly adopting a diet rich in animal protein and they argue that this trend is expected to continue once the prices of chicken meat falls.

Over 60% of large scale poultry farmers indicated that their produced quality chicken-meat face a serious challenge in guaranteeing consistent standards. Large poultry farmers interviewed cited a preference for poultry meat sourced from South Africa and Kenya, where producers/suppliers have demonstrated greater reliability in meeting specifications regarding slaughtering, weight, supply period and quantity.

From both focus group discussions as well as structured interviews from large scale farmers, it was noted that the marketing systems is neither structured nor organized. The poultry products marketing systems is characterized by weak coordination, poor market knowledge and information. There are no formal contractual sales and marketing except Abusol Company operating in Bugesera District.

Commercial poultry farmers access to market and market information through radios, television and social medias, Rwanda Poultry Industry Association (RPIA), and fellow farmers, traders/ buyers of poultry products selling to regional countries and

Majority of these poultry farmers have no formal organized way of marketing their products, only few have used radio, telephone and television to inform the public about their products. It was reported that demand for eggs was high hence the motivation for layer farmers to produce more eggs.

However, their eggs do not meet international standards and are not completive on regional markets. Members recommended the government to help farmers to strengthen the capacity to standards as well as support them establish and implement traceability system so as to increase access to regional and international markets, set up laws on marketing poultry products and set up indicative prices on eggs and meat.

To be competitive members requested for support to upgrade existing technology in farms, encourage Rwandan community to consume eggs, train farmers to increase production by better poultry feeding and poultry healthy care, proper egg and meat handling including transporting them in proper containers such as crates, train farmers to produce cheap homemade feeds that meet the standards, support hatcheries to produce less costly DOCs, produce hatching eggs locally and generally support the production and use of local brooders to compete Chinese ones and subsidize drugs and vaccines.

4.2.6 Environmental aspects of the poultry value chain

4.2.6.1 Overview

In 2017, the annual chicken meat production was 15.2 thousand tones and the eggs production was 244 thousand. The overall target for the chicken production as proposed by the Chicken development roadmap (2017/18-2021/22) was to double the production by 2021/2022 and have annual chicken meat production of 35 thousand tones and egg production corresponding to 513 thousand eggs[1].

The Rwanda Livestock Master Plan 2017/2018-2021/2022 state that chicken industry in Rwanda will transition from largely subsistence to a more knowledge intensive market oriented sub-sector adding growth and value to poultry products. Both the family and specialized commercial operations will be transformed by using improved and highly productive breeds to ensure household food and nutritional security and higher incomes and significantly contribute to achieving the all-meat consumption needs of the nation.

However, the poultry value chain subsector is associated with significant use of natural resources such as land, water and energy and contributes to the environmental issues such as greenhouse gas emissions, generation of wastewater, loss of nutrients to water and air and biodiversity loss, erosion in the vicinity of farms etc... These problems may contribute to environmental impacts such as climate change or eutrophication, water degradation and underground water pollution which threaten ecosystems and human health.

The production of poultry meat and eggs is estimated to account for 8 percent of the global annual emissions of GHGs from the livestock sector, or 606 billion kg of CO2e, with about half coming from feed production. The average emission intensity of broilers is estimated at 5.4 kg of CO2e per kg of carcass weight, and for layers at 3.5 kg of CO2e per kg of eggs. Poultry production is highly dependent on imported feed in large-scale operations. Such production is responsible for 57 percent of the sector's emissions, including 18 percent from land-use change to accommodate more feed crops. Emissions associated with manure storage, removal and processing are also significant, at 11 percent[2].

Environmental aspects of the poultry value chain has been evaluated and analyzed through field data collection, interview, literature review and information compilation & production of the report.

4.2.6.2 Objective

The objective of this component is to assess the environmental aspects of the current technology in the poultry value chain and be able to recommend green and environmental friendly technology that would enhance the PVC resilience to the climate change.

4.2.6.3 Environmental Legal compliance

i) Constitution of Rwanda

It should be noted at the outset that, all laws and regulations in Rwanda must be aligned with principles in the Constitution. The Rwandan Constitution was approved in a national referendum and adopted in Parliament on 25th December 2015. It defines the principles and overall legal framework for the management of the water, energy and agricultural sector. According to the Constitution of the Republic of Rwanda in:

Article 3: Supremacy of the Constitution: The Constitution is the supreme law of the country. Any law, decision or act contrary to this Constitution is without effect.

[1] Rwanda Livestock Master Plan, 2017
[2] Environmental Performance of poultry supply chains, FAO

Article 22: Right to a clean environment: Everyone has the right to live in a clean and healthy environment.

Article 35: Right to private ownership of land: Private ownership of land and other rights related to land are granted by the State.

A law determines modalities of concession, transfer and use of land.

ii) Law N°48/2018 of 13/08/2018 on Environment

This Law determines modalities of protecting, conserving and promoting the environment in Rwanda. It promotes the 5 environmental conservation principles and the 1st stress on precautions that need to be made before implementation of any activities considered or suspected to have negative impacts on environment.

Article 3 says that; activities considered or suspected to have negative impacts on environment must not be implemented pending results of a scientific assessment ruling out the potentiality of such impacts.

Article 18: No person is authorized to discard solid waste in an inappropriate place. Solid waste must be sorted, collected and transported to appropriate destination in accordance with relevant laws.

Article 21: Mainstreaming of environment and climate change in the development planning process. Every socio-economic sector must mainstream environment and climate change in the development and implementation of its policies, strategies, plans and programs.

Article 29: this article express the state obligation to the use of renewable energy, effective energy use, and use of other types of energy which may replace that derived from wood.

Article 46 states also that any person who does not carry out environmental impact assessment before launching any project that may have harmful effects on the environment while it is required, is punished by suspension of his/her activities or closure of his/her association and ordered to rehabilitate the damage to environment, persons and property. He/she also pays an administrative fine of two percent (2%) of the total cost of the project.

iii) Ministerial order no 001/2019 of 15/04/2019

The Ministerial order no 001/2019 of 15/04/2019 establishing the list of projects that must undergo environmental impact assessment, instructions, requirements and procedures to conduct environmental impact assessment in its annex 1 lists the following:

All buildings classified as residential, commercial, administrative or institutional sports facilities, social, cultural, and assembly and religious buildings, hotels, health facilities, educational buildings, or other publicly accessible facilities fulfilling at least two of the following conditions:

Having capacity to host more than five hundred (500) people;

Having a total floor area exceeding one thousand and five hundred square meters (1500 sqm); Built in plot size exceeding one thousand square meters (1000 sqm).

iv) Instructions Nº 01/09 of 15/09/2016 of the City of Kigali Council relating to hygiene in the City of Kigali

The poultry value chain actors operating within the city of Kigali should observe these instructions in relation to the hygiene especially provisions in the bellow highlighted articles:

Article 12: Areas in which waste disposal is banned Waste must not be piled up in places where they can attract germs or be harmful to environment, people and properties. While waiting for its transport to an appropriate place, waste must be put in a secluded place and in appropriate containers.

Article 14: It is prohibited for anyone to dump waste in an inappropriate place. It is prohibited to burn any waste.

Article 18: b) Every household, any institution or any building whatsoever shall have sufficient water tank for rainwater harvest;

Article 78: Any person who wishes to operate a slaughterhouse must have an authorization issued by the competent authority.

Article 79: A slaughterhouse building must meet the following requirements:

It must have an occupation permit;

It must have a clean slaughter floor, roofed and with a ceiling sustained by pillars only; It must have a slaughter space with tiled walls and tables;

It must have a slaughter space with sufficient warm and cold water; It must have a slaughter space with sufficient lighting system;

It must have waste drainage and disposal;

It must have a space for washing and cleaning the intestines;

It must have sufficient and separate lavatories for men and women; It must have hand washing equipment;

It must have a spacious space for hanging meat for the purpose of inspection;

It must have a room for storing suspect meat segregated from healthy meat waiting for final decision;

A disposal pit for meat labelled unfit for human consumption;

A cold chamber, which is big enough;

Its surrounding must not be covered with dust or mud (there must be a garden or pavers).

Article 80: Necessary equipment for a slaughterhouse are the following:

Metal storage cabinet;

Insect repellants;

Appropriate waste storage containers;

Sufficient water containers;

A sterilizer;

A meat dispatching table;

Water heaters

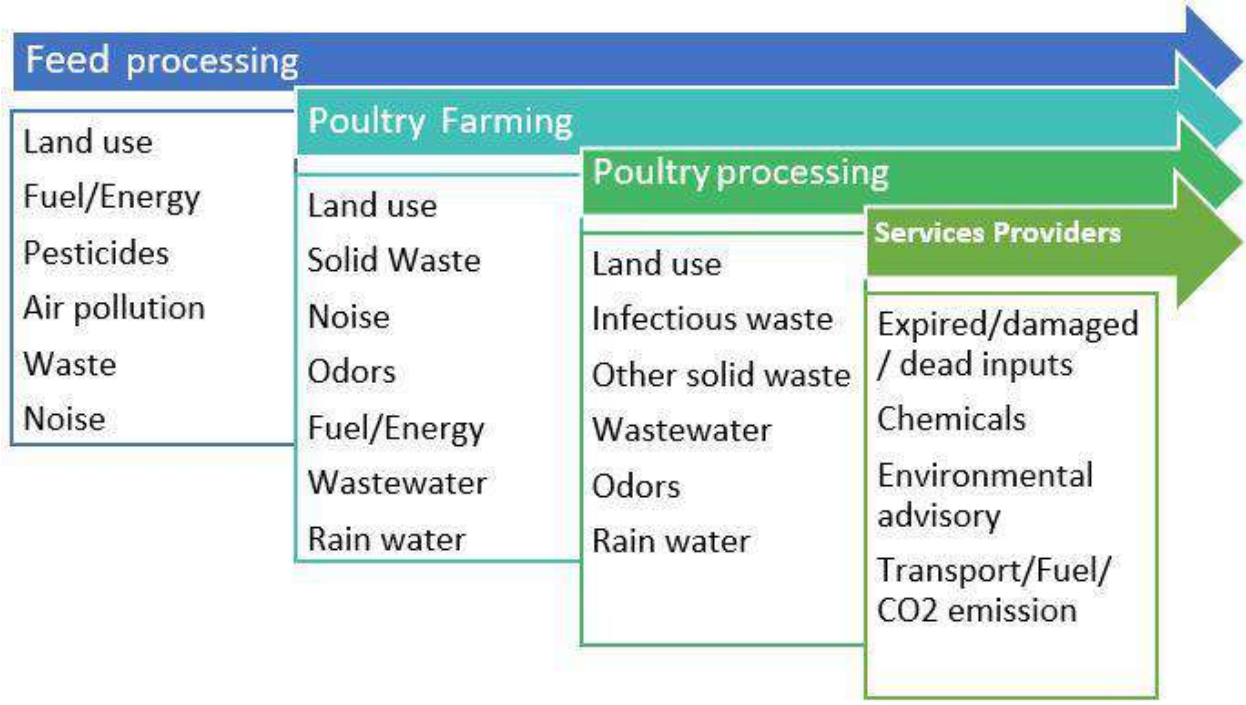
v) Law N° 17/2019 of 10/08/2019 relating to the prohibition of manufacturing, importation, use and sale of plastic carry bags and single-use plastic items

Article 3: The manufacturing, use, importation or sale of plastic carry bags and single-use plastic items is prohibited.

vi) General observation

In general the poultry sub-sector has been assessed to be climate resilient as the projects in the PVC doesn't require a lot of land, observed efficient natural resource use (water and energy), low emission (8 % of the global annual emissions of GHGs from the livestock sector). However, among the interviewed and visited actors in the poultry value chain, none of them has carried an environmental impact assessment before commencement of his project, a low consideration to the environment aspects has been observed (mostly in regards to appropriate land use, wastewater treatment, solid waste management, fuel/energy use, nuisance to the neighboring etc…). The graph below shows the most environmental aspects assessed within the PVC during this study.

Figure 9: Environmental aspects assessed during the study



vii) Current status/findings

a) Appropriate and efficient land use

In regards to the appropriate and efficient use of land, the study has evaluated the compliance of land use for the poultry value chain actors. In general actors in Poultry Value Chain (PVC) comply with the land use plan at the percentage of 87%. During the focus group discussions, it was noted that some of small and middle farmers do not have information on the land use plan specific to their farmland. Few small farmers recognized that they use their residential habitations to raise chickens.

Considering the proximity of the PVC activities locations to environmental sensitive areas (floodplains, lake, natural forest, rivers, swamps and wetland), 12,04% have been reported to be located in the vicinity of those environmental sensitive areas.

b) Solid Waste management

Waste management practices were evaluated based on the waste management hierarchy principle that prioritize waste Prevention, Reduction, Reuse, Recycle, Energy recovery and disposal. This component was considered important to the study, because of potential impacts that may be created by poor management of waste in PVC in terms of nuisances to the neighboring habitations (bad odors, flies, rodents) and soil, air, water pollution.

Considering the current practice in waste management, most of actors (76.06%) in PVC confirmed that; in order to implement the recommended waste management hierarchy, they segregate their waste into biodegradable waste, non-biodegradable waste (mostly recyclables) and dead birds.

Preferable recycling & disposal method of generated solid waste practiced in PVC are the following (in parenthesis is the percentage of the volume of waste recycled or disposed using the indicated method):

- Composting (44%)
- Taken by a waste management company (32%)
- Animal feeding (12%)
- Dumped in our own disposal pit (8%)
- Taken to recyclers (4%)

c) Wastewater management

For wastewater treatment before releasing into environment, most of actors pour wastewater into pit dug for that purpose. One big farmer, feed and poultry processor (ABUSOL) has installed an adequate wastewater treatment plant. The system has 25 m3/d capacity to be increased to 100m3/d by year 5.

d) Energy efficiency ***Source***

of energy for lighting

The main source of energy used for lighting in the PVC is local national electricity grid for 75.9%, solar energy at the rate 18.8% and 6.3% for other sources like generators. Some of the farmers use LED lights to reduce energy required for lighting in the poultry houses.

Figure 10: Picture showing use of LED Lights in poultry housing

Source of energy for heating

In first phase of the chicken farming (layers and broilers), the farmers need energy to keep the convenient temperature in the brooder house. During this audit study it was found that 77.4% use traditional brooder (use of charcoal) while only 9.7% uses modern brooder (use infrared lamps).

e) Rainwater harvesting system

Most of farmers have installed rainwater-harvesting system on the poultry housing. During focus group discussion some of small farmers have confirmed to use the harvested rain water is in cleaning poultry equipment.

Figure 11: Rainwater harvesting system installed on some of the poultry houses

f) Fire safety

Big farmers, poultry products and by-products processors, hatcheries, at the rate of 69.27%, have at least portable & mobile fire extinguishers in their facilities to be used in case of fire. For additional means, few of them have installed fire detection & alarm system at the rate of 12.3% and automatic sprinkler (15.3%).

During the focus group discussion, most of the interviewees confirmed to have no any means of fire prevention and fighting.

g) Specific recommendations

For the sustainability of the projects in the poultry value chain, it is crucial to consider environmental aspects in the planning phase of the projects and integrate measures to control those aspects during project implementation.

Based on the observations and data collected in this study, the consultant has drawn the following recommendations:

- Commercial farmers with more than 5,000 chickens, poultry product and by-products processors, and feed producers should be required to conduct Environmental Impact Assessment specific to the location of the project before they start their project.
- Poultry product and by-products processors should have means to treat wastewater before release into environment.
- Commercial farmers with more than 5,000 chickens, poultry product and by-products processors, and feed producers should be required to have personnel in charge of environment, health and safety management.
- There should be means to detect and extinguish fire in all premises, facilities.
- In order to reduce nuisances to the neighbors and avoid conflicts, it is recommended to apply the best practices in waste management by adopting the waste management hierarchy and installing wastewater treatment facility.
- Actors in the poultry value chain are recommended to establish management system in regards to environment, health and safety, specific the their activities.
- We recommend also trainings on the best way to manage environmental aspects observed in the poultry value chain.

4.3 Analysis of the Current Available Poultry Value Chain Technology Capacities

The analysis of the current available PVC technology capacities mainly centered at assessing managerial/technical skills, poultry housing system, chick genetic material, feeding, watering, disease control and poultry product handling and processing as well as marketing.

4.3.1 Managerial/technical skills

Poultry farming needs both managerial and technical skills for it to bear fruits. This study established that more than half of large poultry farm owners are highly educated with Bachelor, Master or PhD degree and 84% have a work experience of 5 to 24 years indicating that they may have considerable level of managerial skills. Available literature indicates that the level of education of individual farmers plays a leading role in the adaption of innovation and technology. Therefore, the fact that owners of commercial poultry have a high level of education is an asset to poultry farming and this may have helped them to overcome fear and adopt the use of technology as compared to ordinary farmers who are not educated. High levels of education might have contributed to proper management of the farm through keeping books of accounts, employing educated technicians, observing minimum technical requirements such as stocking density, proper feeding, watering and in bio-security management.

However, when asked about the capacity challenges in terms staff technical skills, all PVC actors (interviews and FGDs) indicated lack of poultry specialized technical skills to adequately manage and operate poultry enterprises. Technical skills are sourced from outside the company particularly in Kigali and this explains why most of these businesses are located in Kigali and within its vicinity.

4.3.2 Poultry Housing system

As indicated in 4.1.1 part ii) technology use in poultry housing system in Rwanda is low. For example, out of 31 commercial poultry farmers surveyed throughout the country, a considerable number of 44% use deep litter system and its application and management does not meet appropriate requirements. For example there is constant spilling of water in the deep litter thus creating favorable conditions for pathogens. In Rwandan context, most farmers, litter is removed after 45 days in broilers or 72 weeks for layers.

Deep litter is an animal housing system, where straw or sawdust material is spread on the floor for poultry to sleep on and keep droppings. Usually as the litter is soiled or destroyed new layers of litter are added by the farmer to prevent poultry from stepping on bear cement floor.

The system often results into the production of meat and eggs that do not meet international standards and therefore cannot access markets that need such standards as eggs and meat from deep litter system to susceptible to infections.

On the other hand, the cage system which is used by a very small number applies a technology of maintaining 3 hens in a cage which allows the farmer to confine a big number of chickens on a small space. It also allows farmers to easily feed chickens, water them, collect eggs and dispose waste.

Some farmers have understood the importance of constructing two tiers houses than one tier houses for keeping a big number of chickens on a small space while other farmers prefer to mix both housing systems in the same or different houses.

The study revealed that the nature of houses differs from farmers depending on climatic conditions that range them into open, partially closed or closed houses.

4.3.3 Feeding and watering system

Adequate feeding and watering is essential for poultry health. However most of the feeding and watering system in Rwandan poultry does not do so. 57% and 75% of large farmers respectively provide water and feed to chicken manually. With manual feeding and watering, the chickens are often not adequately fed and thus negatively affect production. Poor feeding and inadequate access to water increases chicks' mortality. Both of these factors reduce farm production and profitability.

Due to high cost of automatic feeding and watering system only 39% and 23% of farmers apply semi-automatic/or automatic supply of water and feed to their poultry farms. Lack of electricity was also reported as hindrance to the adoption of automatic feeders and waterer. Some farmers have solved this by use generators or solar energy and thus farm profitability.

4.3.4 Ventilation

Ventilation is naturally provided and is in most cases inadequate. Due to lack of proper ventilation the temperature and the humidity of the poultry house is not kept in the suitable range and this affects poultry productivity. The study recommends the use of environment controlling system will be ideal.

4.3.5 Heating system

The fact that most commercial poultry estimated at 77% heat brooding houses using traditional brooders made up of used pots, and charcoal stoves is major hindrance to poultry productivity as temperature may affect feed conservation hence producing less eggs and meat per chick. Use of pot/charcoal stoves is not environmental friendly, inefficient and often results into diseases hence resulting productivity. The use of modern brooders such as radiant or infrared lamps estimated at 20% of farmers is constrained by funds.

4.3.6 Produce handling and processing

Eggs collection and sorting by size are mostly done manually by farmers as reported by 80% of farmers. 39% of farmers manually slaughter chickens. This manual handling and processing of poultry products is presumed to be unhygienic and markets that require high standards cannot buy these products. The egg handling and the common traditional meat slaughtering at farm gate technologies according to commercial poultry farmers interviewed claimed that it excludes them from premium prices offered by international hotel brands operating in Rwanda as well as export markets. With automatic machines, the belt transfers the eggs to the collection machine automatically which moves the eggs to the center package place with human handling and extremely hygienic and efficient.

4.3.7 Bio-security and disease control

Although 50% of farmers claimed to be applying measures for their poultry farms to meet bio-security standards, observations made during field visits to the farm indicated the contrary. Bio-security refers to procedures used to prevent the introduction and spread of disease-causing organisms in poultry farm by ensuring that workers wear neat and clean clothes, boots and apply disinfection before entry and exit from poultry house, avoid contact with outside birds by fencing and discouraging visitors and disinfest if allowed in, disinfect hatched eggs, inspect and use feed from reliable sources, use clean drinking water and dispose waste properly etc.

With automatic removal of waste from the poultry house by use of the scrapers will considerably decrease infection rate and poultry mortality. Weak bio-security measures result into high chick mortality and high costs of treatment leading into loss or reduction in profits. Therefore, the fact that most of these poultry farms use deep litter system, without adequate waste disposal system, use water from the well /spring etc suggests that bio-security system is far from perfect. In fact, farmers have reported incidences where an entire poultry farm was wiped out due to disease outbreak and most likely this was a result of gaps in bio-security measures.

4.3.8 Poultry products and by-products processors

Most processors of poultry products and by-products processors use traditional means such as knives and manually handle the process. These mainly produce whole chicken carcass and do not produce chicken parts or cuts such wings and thighs. It is even difficult to find people selling leg quarters, breast quarters, breast halves and poultry halves. This affects sales as some people may not afford a whole chicken carcass because of budgetary constraints.

However, there are few investors such as ABUSOL and PEAL who process poultry meat using modern machines and supply and sell mainly fresh whole chickens often having subjected to refrigeration consideration for a few days. In addition, these process and supply chicken cuts such as thighs, wings, breasts even offals such as gizzard and heart. The study recommends other processors to buy appropriate machines in order to competitively meet export markets.

4.3.9 Hatcheries

The hatcheries are new and use state of art technology particularly the incubators and accessories. They have competent technical people to operate the machinery. However, production capacity of hatcheries is limited by the low purchase power of farmers. The later should be assisted to increase their purchasing power of DOCs, thus allowing hatcheries to increase the annual number of produced DOCs to be sold.

Other constraints reported by hatcheries included lack of high performing incubators, low skills in managing hatcheries, fluctuations in DOCs prices, dependence on imported hatching eggs, high cost of electricity ad regular power cut leading to losses in hatchery, lack of parent stock for producing hatching eggs in hatchery premises, high cost of feeds ingredients, and feeds and veterinary products

Stakeholders and hatchery owners believe that these challenges can be addressed by developing a strong partnership with MINAGRI and RAB, training in hatchery management from MINAGRI and other partners, financial support to buy and maintain a parent stock in hatchery premises, address the irregularity of power supply, partner with development partners to finance the upscale of the hatchery and upgrade its technology and support study tours to run from experience of more performing hatcheries

Hatcheries cannot compete favorably with foreign markets due to many factors like low financial capital, low skills, lack of affordable credit models, and lack of training centre in hatchery, poor management, and remuneration of middleman who intervene in sales of DOCs and pullets.

Hatcheries have put in place strategies allowing them to compete favorably and these include reduction in selling price for DOCs without charging them travel fees, technical assistance of farmers from start to production stage through extension work provided by a hatchery veterinary technician, supporting diseases management and vaccination programme, feeding management by using good quality feed, dispatch of quality DOCs and good customer care. Hatcheries in Rwanda have developed partnerships with other poultry value chain actors and enablers including and not limited to:

Commercial Layer and Broiler Farmers as their main clients for their DOCs,

Poultry Inputs and veterinary services providers, who supply them with required materials, vaccines, drugs and the extension services, Enablers/regulators & Donors, who provide technical assistance, advices, training, advocacy, set laws and regulations, create a favorable business environment, supply basic infrastructure (water, electricity) to mention few,

Enablers/Supporters who provide financial support for the good run of hatchery business.

4.4 Analysis of the PVC Policy, Strategy and Private investment to increase Competitiveness of the Poultry Enterprises in Rwanda

4.4.1 PVC opportunities, strengths, threats and weaknesses for Improvements

The sub-sector has a number of opportunities and strengths that would transform it if adequately utilized. These include an enabling policy environment, institutional support, and access to essential poultry inputs. However, a number of challenges constrain its full exploitation and these include limited funding, inadequate expertise and inefficient management, limited Research/breeding, disease occurrence, and expensive feeds

The table below gives a summary of SWOT analysis whose details are indicated after.

Table 18: SWOT analysis of the Poultry Value Chain of Rwanda

Strengths	Weaknesses
❖ Existence of an enabling policy environment ❖ Availability of land with a long and secure tenure promotes investor confidence ❖ Institutional support ❖ Availability of veterinary inputs/drugs/vaccines. ❖ Availability of poultry feeds ❖ Availability of high hybrid Day-Old-Chicks (DOCs). ❖ Good weather and day/night cycle ❖ Huge market for poultry products both locally and regionally ❖ Poultry has the potential for rural development as incomes can be generated in the poor parts of the society and on regular basis in the country	❖ Lack of standard poultry housing system ❖ Lack of specialized skills for poultry value chain actors ❖ Inadequate local production of raw materials during off season period and expensive feed imported ingredients make feed supply expensive and unreliable supply. ❖ Dependence on imported fertilized eggs lead to unreliable supply and expensive Day –Old- Chicks ❖ Poor supply for vaccines and essential veterinary drugs ❖ Poor market access for producers due to lack of market organization ❖ Inadequate Capital ❖ Costly and irregular power supply ❖ Poor road infrastructure in rural areas and poor transport systems for poultry products ❖ Poor value chain management and coordination ❖ Limited financing and investment along the entire value chain - investors consider poultry sector as a risky venture or enterprise

	❖ Population not educated on the value of poultry products - no promotion of poultry products ❖ Few actors in large scale production
Opportunities	**Threats**
❖ Poultry sector has a huge potential for regional development, example pproximity to DRC offers a large market. ❖ Poultry products have the potential to contribute to food and nutrition security ❖ Private interests in feed production and processing is continuing to grow ❖ High demand for poultry products due to increased incomes of local communities ❖ Global trend encouraging demand for the consumption of white meat ❖ The African Continental Free Trade Area Agreement (AfCFTA) likely to attract investment ❖ Political will through provision of enabling environment such as policies and strategies	❖ Competition with similar products from the region. ❖ Covid-19 affects markets ❖ Cultural, attitudinal behaviors on poultry products consumption leading to low/poor consumption habits as poultry products are not seen as essential food commodity by local community ❖ Informal slaughter ventures outcompete the existing formal slaughter houses/processors ❖ Weak internal sustainable capabilities along production value chain

4.4.1.1 PVC Strengths

a. Land availability

Most Commercial poultry farmers have adequate land with long and secure tenure for their farming business. This secure tenure system provides confidence for long term investment in poultry farming. For example the found out that 90% of large scale poultry famers reported to having enough land space for production and the ability to extend in the long run. Besides, 27 farmers representing 87% operate on their own land while 3 farmers representing 10% operate on rented land.

b. Enabling policy environment

Investments into agriculture sector including poultry are generally exempted from paying taxes on imported machinery, equipment and raw materials used in the manufacturing process. In addition, the GoR specifically offers a number of financial incentives to boost poultry production. These include VAT-exemptions on agricultural inputs and unprocessed outputs including day-old chicks, ready-made animal feed and ingredients used in the manufacture of feed (cereal brans, oilseed cakes, and salt, mineral and vitamin premixes). VAT exemptions are also made on veterinary pharmaceutical products and laboratory equipment as well as equipment used to prepare and process meat and poultry industry equipment (farm inputs, hatching machines, incubators, cold-room equipment and refrigerator systems, and chicken-feed equipment and feed-processing lines).

Further, agri-businesses with an annual turnover of less than FRw 12 million are exempt from income tax.

This enabling environment aims at reducing the cost of doing business hence enabling poultry farms/firms to produce competitive products both on national and regional markets. It is also expected to attract private investments into the sub-sector.

However, discussions with farms indicated that some of them are not aware of these incentives and there is need for concerned institutions to outreach to farmers and inform and facilitate them to access such facilities.

c. Institutional support

There are a number of institutions supporting farms/firms involved in different poultry value chains. Farmers reported that they receive extension support from RAB, Credit facilities from BDF/SACCOs/Commercial banks, Tax exemptions from RDB/RRA/MINECOFIN/MINICOM as well as general support from local administration. However, there delays in service delivery in most of these institutions and these delays increase the cost of doing business.

d. Availability of veterinary inputs/drugs/vaccines

Poultry farming requires the availability of a number of veterinary drugs and vaccines and other necessary equipments for control and treatment of diseases extension and advisory services. Farmers have reported that they access such drugs and vaccines from a number of private agro-dealers such as agrotech, Agromex and local vet pharmacies as well as importing from outside Rwanda.

Farmers’ access to these veterinary inputs is constrained by high costs, irregular supply and poor quality particularly in upcountry remotes areas. Sometimes agro dealers do not have some of these essential drugs and farmers are forced to travel to Kigali which increases the cost of these items and puts farmers’ poultry at risk. Quality of these essentials has been questioned in some cases and there are reports indicating that the issue may arise due to lack of skills to use them.

e. Availability of poultry feeds

Due to favorable government policies, a number of feed processing plants have sprung up such as Gorilla feeds, Zamura feeds, Huye feeds among other in the last five years. This has enabled commercial poultry farmers to access poultry feeds. However, farmers complain that feeds are expensive, are not always available and are of poor quality in some cases. According to feed processors, this high cost is associated with the high cost of some imported ingredients, costly locally raw materials such as maize and soya as a result of competition for human consumption.

f. Availability of high hybrid Day-Old-Chicks (DOCs)

There are a number of hatcheries that produce and distribute productive hybrid Day Old Chicks to commercial poultry farmers throughout the country. These include local companies such as Uzima Chicken, Easy Hatch as well as imported DOCs from European and Asian suppliers such as

Netherlands, Belgium, Turkey, Germany and India. Although commercial poultry farmers have access to the Day-Old -Chicks, farmers have reported they are expensive and sometimes not available.

4.4.1.2 PVC Weaknesses

a. Lack of standard poultry housing system

Commercial farmers generally do not use modern poultry housing system and this affects the quality of meat and eggs produced by farmers thus reduces chances of accessing international hotel as well as export markets. Most of the commercial poultry farmers use deep litter housing system with no access to clean water, no proper feeding and water system, no proper heating system, no proper ventilation and aeration. These conditions are breeding ground for diseases and this increases chick mortality rate reducing profitability.

b. Lack of specialized skills

Although the Rwandans have kept poultry for a long time, their knowledge and specialized skills in improved management is limited. This is worsened by lack of trained, knowledgeable and skilled extension workers in poultry farming. Poultry farm/firm owners also lack basic skills in poultry farming and rarely employ veterinary experts but rely on calling them whenever there are problems.

Consequently, the delivery of advisory services to farmers for commercial production is still weak. Improving poultry production in rural areas requires community participation through farmer training programs by extension agents for increasing management skills and control of diseases as well as organizing appropriate marketing channels that do not exploit the farmers.

c. Lack of organized marketing

There is generally a lack of organized marketing infrastructure. Few slaughter plants exist. This means that products on the market are unprofessionally handled, resulting in a lack of grades and standards, insufficient market information and expensive products being presented to a market dominated by low incomes and therefore low purchasing power. This explains why most international hotel brands cannot buy Rwandan poultry products.

d. Lack of Breeding and dependence on imported fertilized eggs

It has been reported that the supply of exotic breeds, in the form of day old chicks, has consistently failed to adequately satisfy demand because of the dependence on unreliable imports. Although some hatcheries have been established to address this issue, their effective performance is constrained by low installed capacity, underutilization of the installed capacity for various reasons, lack of capable management skills and lack of capital especially to purchase and manage parent stock. The result is that the supply of Day Old Chicks (DOCs) to commercial farmers is inadequate, irregular and costly. Mortality rates for DOCs are high due to poor management skills. There is a need to establish provincial breeding Centers for both Layers and Broilers and dual purpose chickens that meet international hatchery standards.

e. Inadequate local raw materials production and costly feed ingredients imports

The key constraints regarding the feeding of poultry are feed availability, feed quality and feed costs. The availability of compounded feeds for commercial poultry production is constrained by competing use of the feed ingredients (cereal grains, fish as human food, brewing industry, feed for other animals), and seasonal variation. This competition for feed ingredients and costly imported ingredients pushes up the prices for feeds. It also compromises on quality as suppliers tries to produce affordable products.

The quality of feeds has been one major factor that affects the productivity and therefore the profitability of the poultry industry. This is due to the lack of regulations relating to feed policy, legislations and standards. There are many small-scale feed mixers, which are often unskilled and insufficiently equipped to manage feed milling operations. These produce substandard quality feeds leading to poor growth rates and production. There is need to strengthen institutional and legal framework to regulate the industry.

f. Poor supply for vaccines and essential veterinary drugs

Commercial poultry farmers have reported incidences of disease outbreak that occasionally wiped out entire poultry animals. The common diseases such as Newcastle disease, coccidiosis and Infectious Bronchitis Disease (IBD) and Gumboro are common ones affecting their poultry farming.

Although there is a number of private suppliers of the supply of farm inputs, poultry drugs, vitamins, minerals and vaccines, the supply is still limited to major urban centres. The quality of these inputs is of a low standard, especially for those that require a cold chain such as vaccines. The cost of the inputs is often high because they are packaged in volumes (such as 1000-5000 dose vaccines) that are not suitable for use by small-scale farmers.

In addition, there are very few extension workers trained and skilled in the diagnosis and treatment of poultry diseases. In fact, most extension officers at the sector level have little or no skill in poultry diseases diagnosis and treatment hence most farmers use private veterinary technicians from agro-tech and individual operators.

g. Inadequate Capital

Like the other sub-sectors in agriculture, the poultry industry is constrained by lack of capital investment. Conventional financial institutions are reluctant to give loans to farmers. This limits the numbers that most farmers can keep and this in turn limits their ability to maximize the profit associated with larger-scale production

h. Inadequate Business Development Support services

Poultry sub sector is a new area that has previously received little attention from government. Because the existing agriculture policy was general and did not pay more attention to poultry, even enablers did not support it as well. Business Development Support Services usually where financial support has been provided and some work is going. During Focus Group Discussions, many PVC actors reported having got any support from any business development support services and are not aware if ever they exist.

i. Costly and irregular Power Supply

Rwanda generally has high electricity tariffs which affect the cost of production, especially for those that rely on electricity such as feed millers. High electricity tariffs increases the cost of feeds resulting into increases in the cost of chicken meat and eggs hence making them uncompetitive.

j. Poor road infrastructure in rural areas

In certain rural settings road network is poor and this makes it difficult to transport raw materials (eg feeds from manufacturers), DOCs and finished products such as eggs or meat products to end users. Lack of appropriate packaging materials like crates for eggs worsens this problem as quite often use of brackets results into breakages and heavy losses to farmers. This makes the supply of these products unreliable, very expensive and uncompetitive on the market.

4.4.1.3 PVC Opportunities

a. Proximity to DRC offers a large market.

Rwanda has a huge market in Democratic Republic of Congo which does not require difficult market requirements and does not costly logistics to access.

b. Global trend encouraging demand for the consumption of white

Due to health concerns, globally people are shifting from consuming red meat to white. This will encourage people to invest in poultry farming.

The African Continental Free Trade Area Agreement (AfCFTA) likely to attract investment

The recent Africa Continental Free Trade Area Agreement will attract investment in poultry investment especially egg and meat processing. It may attract investment in hotels which will buy poultry products.

3.4.1.4 PVC Threats

a**. Regional Competition**

Competition with similar products from the region is a big threat to the industry as the regions continues to produce cheaper poultry products.

b. Covid-19 may affect markets

Covid-19 has already negatively affected the industry and it is likely be much worse if it continues.

4. 5 Poultry value chain technology gaps

With favorable government policy environment, progress has been registered with respect to the adoption and use of the improved technologies. However, few commercial poultry farmers have adopted these improved technologies. There are a number of technology gaps along the whole poultry value chain as discussed in section 4.2. There are gaps in:

a) Inappropriate poultry housing system meeting standards-house are substandard and do not offer conductive conditions for poultry growth,

b) Inefficient delivery system for poultry feeds- Feeding is done manually hence chicken don't eat enough and most of it is spent on energy and is not converted in eggs or meat,

c) Poor ventilation system- Depends on nature which frequently changes

d) Inefficient ways of collecting, storing and utilizing compost- Manually done and this increases risks of spreading diseases

e) Weak bio-security/disease control measures-

f) Inefficient method of product handling and storage of Produce-Manually done increasing chances of contamination and infection.

g) Poor quality feeds, and

h) Inadequate marketing and sales promotion,

i) Limited capital Investment,

j) Limited technological skills.

Another technology gap is the development of better chicken breeds. Most hatcheries lack parent stock/grandparent and rely on the use of imported hatching eggs. This often results into poor quality and expensive chicks.

Marketing and branding is another gap that needs to be addressed. Local poultry farms need to work hard toward having a brand name that will enable them promote and sell their produce.

4.6 Poultry value chain policy gaps

4.6. 1 Background

The Government of Rwanda has adopted favorable policies and strategies to support the poultry industry and attract private sector investments into the industry. Noted among them are: Strategic plan for agriculture transformation 2018-24, 7 Years Government Programme: National Strategy for Transformation (NST 1), 2017 – 2024; Strategy & Investment plan to Strengthen the Poultry Industry in Rwanda (MINAGRI, 2012) and Rwanda Livestock Master Plan (ILRI, 2017). Due to these policies and strategies, some progress has been achieved. However, there are policy gaps that need to be filled for the sector to achieve planned targets.

4.6.2 Agricultural interventions have in past provided general support with little attention to poultry

Due to this the sub-sector has many obstacles hindering its full exploitation and there is need for comprehensive development program that will address all issues from housing, feeding, DOCs, bio-security to marketing etc as detailed in 5.1 below. Give poultry subsector special treatment by designing special poultry value chain programme offering appropriate financial packages including grants/subsidies to uplift it to a functional level.

4.6.3 Inadequate intervention to generate genetic material appropriate to Rwanda

There is a need for government to support development of genetic resources appropriate to Rwanda local conditions. This can either be helping hatcheries to access parent stock cheaply hence cheap DOCs.

4.6.4 Decentralized extension/veterinary service system is weak and lacks specialized skills for poultry farming

This need to support small commercial poultry farmers by strengthening extension services at the decentralized levels and equipment them with specialized skills/essential drugs to help small commercial farmers who cannot afford the services of private vets.

4.6.5 Commercial poultry farming falls under many institutions but one some seems to be in charge

So many actors are involved in supporting the sub-sector but their efforts are not coordinated hence duplicating efforts and there is no synergy, no sharing of essential information on markets and other essentials

4.6.6 Inadequate awareness and enforcement of regulation and standards

There are regulations and standards regulating the poultry value chain whose awareness and application will enable actors to increase quality products and participate in premium markets. Yet most actors do understand them and enforcement is weak. There is therefore need for government to inform the poultry chain actors on existing regulation as well as strengthen reinforcement.

4.7 PVC linkages, marketing systems and challenges

The study findings from both large and middle scale farmers indicated a noticed growing domestic and regional markets for poultry meat and eggs. Eggs and broilers are produced by small, medium and large poultry farmers, with the majority of output purchased by small traders for delivery to city outlets (wholesalers, exporters and retailers). In addition to domestically produced poultry products, wholesalers also supply retailers with imported eggs and/or broilers.

Retailers supply eggs and broilers to hotels, bakeries, street vendors, fast food chains, restaurants and households throughout the country. The end consumer price of an exotic-breed egg is FRW 80-100 in Kigali and FRW 60-70 in other urban and in rural areas.

Some poultry farmers deliver eggs directly to retail outlets. Most large-scale farmers operate slaughtering houses, delivering broilers directly to retail outlets. Spent layers, the meat of which is of poorer quality, are distributed through the same market channels. The Rwandan market for poultry products is dominated by exotic-breed eggs and broilers. A small quantity of indigenous eggs and hens are sold directly to consumers at rural weekly markets, or through middlemen known as collectors. Collectors sell to travelers along the highway to Kigali, DRC and in recent past to Burundi, or to food outlets and residents in neighboring urban areas.

According to focus group discussion (FGDs) by medium and small scale farmers, consumers prefer large egg with yellow yolks, with some requesting details of origin. The majority of eggs and broilers are sold on domestic markets, in rural villages, cities and Kigali.

The bulk of poultry-product exports are marketed in the Kivu provinces of the DRC, accessed via Western province border crossings in Rwanda’s Rubavu and Rusizi districts. A small proportion of exports also used to cross in Burundi.

The main competition to Rwandan eggs’ export used to come from Uganda. Both the domestic and regional markets for poultry show signs of steady expansion, spurred by population growth, increasing urbanization and associated changes in diet.

The study findings reported that 70% of the large scale poultry farmers indicated that medium- to high income urban residents of Kigali and the wider region are increasingly adopting a diet rich in animal protein and they argue that this trend is expected to continue once the prices of chicken meat falls.

Large scale farmers contend that Rwanda Poultry Industry has the capacity to meet local demand for meat and eggs. However, the same farmers argued that the high price of domestically produced eggs exerts a significant pull on regional producers (Uganda, Kenya and Tanzania). The price of an exotic egg on the Goma and Bukavu retail markets is FRW 160—more than three times that in Kampala, Dar-Es-Salam and Nairobi, where prices are around FRW 44, FRW 46 and FRW 52, respectively. At such low prices, Rwandan eggs cannot compete with imported eggs on the domestic or DRC markets according to the Cost-Benefit Analysis of Rwanda’s Poultry Value Chains - Development Discussion Paper (Mikhail Miklyaev et al., 2017).

Over 60% of large scale poultry farmers indicated that their produced quality chicken-meat face an serious challenge in guaranteeing consistent standards. Large poultry farmers interviewed cited a preference for poultry meat sourced from South Africa and Kenya, where producers/suppliers have demonstrated greater reliability in meeting specifications regarding slaughtering, weight, supply period and quantity.

From both focus group discussions by middle and small scale farmers as well as structured interviews from large scale farmers, it was noted that the marketing systems is neither structured nor organized. The poultry products marketing systems lacks coordination as well as market knowledge and information. There are no contractual sales and marketing.

As specific recommendations to poultry marketing system, The Ministry of Commerce and Trade (MINICOM) in partnership with Private Sector Federation (PSF) and Rwanda poultry industry association (RPIA) need extensively lobby for external markets for Rwandan poultry products as part of big market blocs like the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC), CPGL, to take advantage of broadened bilateral political and diplomatic ties with several countries from the Economic Community of Central African States (ECCAS) bloc, to boost poultry product exports to 11 member countries, the largest in central Africa with over 134 million people to exploit the market opportunities in the ECCAS’countries. It should be noted that Rwanda has much to offer the region in terms of a stable banking sector, well-implemented macro-economic strategy, transparent investment and low levels of corruption.

With regard to poultry feed marketing, the study found out that the price of poultry manufactured feeds varies from Rwf360 to Rwf400 a kilogram, and this was echoed by all farmers from the three poultry production categories (large, medium and small scale) with farmers strongly arguing that feed prices are high compared to their yields. They contended that during harvest season, prices of feeds go down because raw materials such as maize become more affordable, but they go up when it's not harvest season. MINAGRI should improvise appropriate ways to address the issue through facilitating availability of affordable raw materials in all seasons.

Both middle and small scale poultry farmers urged that that their chickens often die as a result of lack of skills on poultry keeping technologies. "We had no training, or skills in poultry farming, we thought it's only about rearing chickens," majority of the farmers lamented from focus group discussion.

4.8 Upgrading, Out scaling, and Improving Technological Capacities

Although some commercial farmers have attained some level of technology capacities in their businesses, majority of them still use low-input technology and there is need to support them to upgrade, out-scale and improve their technology capacities.

The scaling up of the specialized/commercial chicken systems involves two things mainly:

a) increasing the scale of operations by increasing number of birds for commercial layers and broilers kept per farm with corresponding infrastructure and entire system.
b) increasing the number of specialized farms.

This can be achieved by providing much needed low interest long term loans for working Capital as well as development Finance to:

i) Support poultry infrastructure development with efficient system for feeding, watering, ventilation, egg/meat handling and bio-security system.

Enable commercial farmers to construct standard housing for broilers and layers

Equip the housing system with semi-controlled sheds/or controlled sheds, automatic drinkers /tube feeders, generators, ventilators, iii) equip houses with table eggs storage refrigeration plants, iv) efficient ways of collecting, storing and utilizing compost and support them to develop and implement a strong bio-security system to enable access market from international hotel brands operating in Rwanda.

ii) Support commercial farmers, hatcheries and processors to acquire affordable and quality poultry inputs

Facilitate commercial farmers to address of the issue of poor quality and costly feeds by giving grants to maize and soya farmers to increase production hence lowering price per kg, facilitate import of maize and soybean for making animal feeds in case there is short supply in Rwanda, build capacity, support Rwanda Standards Board and Food and Drug Authority to test, regulate feed quality and ensure compliance, and sensitize commercial farmers on importance of use of quality feeds.

Support hatcheries to address the issue of parent and grandparent stock as well as commercial poultry farmers to purchase a considerable size of Day-Old – Chicks to enable hatcheries operate at full capacity.

3. **Facilitate the development of poultry market by:**

Organizing commercial poultry farmers, processors and traders of poultry products into a traders' associations to enable them lobby and advocate for better prices, look for markets and

Support them to acquire cold chain infrastructure and support existing producers and processors of poultry products to acquire equipment to cut and process meat, properly handle and process eggs.

Support branding, marketing and better ways of sales promotion

4. Support the development of efficient extension system for provision of affordable and efficient services by:

Support private veterinary services providers, organize, mobilize and facilitate them to strengthen their association and support them to procure vaccines and drugs in bulky

Capacity building of decentralized extension agents in diseases diagnosis and treatment

5**. Support proper functioning of stakeholders to enable them provide efficient services by:**

Capacity building for government institution to strengthen their capacities for disease surveillance, quarantines, supervises and control including supporting RAB to acquire vaccines in case there is an outbreak that needs mass chicken vaccination.

Strengthen small commercial farmers' cooperatives/enterprises or forming new ones where they are absent to enable them to upgrade production through the use of the hybrid pullets and engaging in common procurement of farm inputs; negotiating better prices for their products; capacity building for members through training activities; and training members on how to formulate their own poultry feed.

6. Strengthen stakeholders' coordination through

Supporting the formation of stakeholder working group including supporting initial meetings and develop mechanism its operations

Helping them develop ways of sustaining its operation such as member contribution, charging a fee of poultry sales and fund mobilization from NGOs.

7. Provide business support services to poultry investors by:

Development of brochures indicating specially importance of investing in poultry, incentives provided by government such as importation machinery and raw tax free, exemption on VAT and income tax for small businesses

Support investors in poultry farmers/processors with development of business plans

Develop and implement a mentorship programme to strengthen technical skills of new and promising poultry farms/firms especially on proper feeding, watering, diagnosis and treatment of diseases, and bio security management.

Support processors to develop and implement standard compliance schemes including bio-safety and HACCP systems as well as guidelines and standard operating procedures for operation of hatcheries and breeder farms.

Support them to develop and implement standard operation procedures

4.9 Economic, Environmental and Financial sustainability of the PVC in Rwanda

Ensuring economic and financial sustainability of the PVC in Rwanda will require owners and actors to put measures to ensure cost recovery, efficiency and avoid environmental degradation. Poultry farming is by nature economically and financially sustainable because chicks are efficient at converting feed s into eggs/meat. However, there is need to use quality feed for better conversion and feed efficiencies, treat poultry and prevent diseases and this will ensure economic, environmental and financial sustainability.

Therefore, this section assesses the sustainability of poultry production with to respect to the environmental, economic/financial and social dimension.

Poultry production has considerably grown due to increased population that has dictated people to shift to areas that production more per unit area. Poultry production offers Rwandan a source of animal protein, and as well as constitutes the income to owners hence contributing to the attainment of global Sustainable Development Goals (SDG) including SDG1 on Zero hunger, SDG3 on Good health and wellbeing and SDG8 on Decent work and economic growth.

However, commercial poultry production contributes to emissions of greenhouse gases, loss of biodiversity and depletion of finite natural resources hence hindering the attaining of other SDGs such as SDG13 on Climate action and SDG15 on Life on land.

Therefore, sustainable poultry production must put in measures that can overcome the above challenges so that the production maintains biological diversity, regeneration capacity, productivity and the ability to fulfill these now and in the future. This will ensure the attainment of significant ecological, economic and social functions at local, and national levels without destroying the ecosystem.

To ensure sustainability of commercial poultry production, efforts should be made to manage environmental impact of required feed production to the pollution caused by different production systems, and to the management of resulting harmful waste products.

Nutrient pollution and emissions such as greenhouse gases will pose serious environmental challenges whose solutions should be sought to reduce the environmental impact. The intensive use of scarce natural resources, such as land exploitation and large monocultures of grain and soy, is another major environmental concern associated with the expansion of poultry production

Economic sustainability in poultry production relates to the economic output, productivity and efficiency of the production process that also correlates strongly with the other dimensions of sustainability in poultry production. For example, improving poultry health and immunity improves the efficiency of the process by which production inputs are converted into production outputs, and thus the economic return of this process. This also applies to environmental sustainability, as reduced production efficiency may lead to inefficient resource use, and hence a higher impact per unit of meat /egg produced. However, in some areas where provision of veterinary services is inefficient there is potentially large economic costs associated with improving poultry.

The social sustainability of poultry production is affected by a number of factors. These include the use of antibiotics and resulting residues as well as in food products, pose a threat to human health. The working environment may also constitute a risk to human health, since workers are exposed to noise, and an increased risk of respiratory diseases and injuries.

In addition, the odours emitted by poultry houses may negatively affect neighboring residents. To attain environmental sustainability, efforts should be made to properly dispose to avoid emitting odurs and then use poultry litter properly after composting so it is used in farming.

On a positive note, poultry production contributes to food security and provides consumers with an affordable protein source.

To be able to mitigate the negative effects and promote positive attributes of poultry, there is need to look at socio-economic, legal, education and cultural context before implementation of any PVC project.

It is also recommended involve stakeholders especially women and youth and empower them and this will be critical in facilitating beneficiary selection and strengthening partnership and cooperation.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Strategies for NIRDA interventions in provision of technology, technical industrial skills and business advisory support in upgrading and improving technological capacities competitiveness in the PVC

5.1.1 Introduction

The study assessed and analyzed the potential for NIRDA to upgrade technology use in the Poultry Value Chain (PVC) by evaluating the available technology in the PVC and its potential to strengthen the effectiveness and efficiency of the PVC. The study then identified potential PVC players who would be a stake in upgrading the technologies.

After the analysis of the current technology gaps as well as challenges identified in the poultry audit study (in form of technology, knowledge and technical aspect of the value chain) the study proposed the two approaches (4Ps model financing model and the establishment of the center of excellence as the main NIRDA interventions to address the technology gaps. To intervene in addressing the technology gaps, NIRDA will apply “Open Calls” approach to provide technical and logistical support to existing enterprises with high potential for upgrading, extending and optimizing operations to improve efficiency and becoming more competitive.

5.1.2 4Ps Model

This study proposed 4Ps model guidelines to assist NIRDA’s Open Call Selection Committee in identifying and selecting PVC enterprises along the PVC with the highest potential. These guidelines were developed based on the technology gaps identified in the PVC and the specific nature of the value chain function. 4Ps model was developed based on the current technological gaps and challenges and the business nature of the poultry industry in Rwanda as shown in the table below.

The table below why the study promotes the 4Ps model in upgrading and improving technological capacities competitiveness in the PVC.

Table. Why the study promotes the 4Ps model in upgrading and improving technological capacities competitiveness in the PVC

Lack of enough guarantees in PVC enterprises	Reluctance of financial institutions as well as insurance companies tosupport the financing of PVC actors/enterprises	Low level of engagement of private sector
The majority of PVC operators have a problem with offering enough guarantees to be considered as collateral.	Financial institutions believe that PVC enterprises are not immediately productive (Generating income investment activities) and sometimes associated with high risk.	A very limited number of private sector partners are involved PVC infrastructure development.Besides, most businesses in this value chain are not insured

The 4Ps model involves public, private and producer partnership. The public, private and producer partnership (4Ps) model will be financing mechanisms to be used by NIRDA to support investments in the PVC along the Public-Private-Producer Partnership (4Ps) model. The 4Ps model is a financing model which allows poultry value chain to be financed jointly by several actors involved in PVC, namely the private who buys and sells the production, the poultry farmer as the producer and the public sector which supports the value chain of that production for example NIRDA as a public operator, large scale poultry farmers as the producer and private agribusiness operators who in this case is the private investor (individual or company) who puts his money in value addition or processing poultry products businesses (he buys meat and eggs from the producer/poultry farmer, adds their value, or process them into other poultry final products, and sell them to the last consumers). This model will be managed using NIRDA grants by BDF. In this model, MINICOM/NIRDA will recruit a service provider who will develop business plans, fine-tuning them till the business is fully approved to access NIRDA grant.

4Ps model allows putting in place all necessary measures to control and making a close follow up of each step of investment and render the beneficiary more accountable to the use of grant. That model facilitates in financing individuals poultry enterprises, companies, cooperatives, and even joint business between individuals or companies with cooperatives. The model will ensure poultry value chain enterprises/operators to start their business with assurance of a chain of buyers and sellers in the value chain.

Based on the above challenges faced by the poultry value chain in Rwanda, this 4Ps model will apply three Approaches.

Private Led

This approach will be based on partnership between the public (NIRDA), private investor and producers in this case poultry farmers. In order to identify potential partnerships between private and producers, NIRDA technical and business plans service providers will act as facilitators, identifying the most suitable candidates and promoting/supporting these partnerships.

2: Joint Venture

This approach is based on a joint business plan between organized producers and private sector who will venture together in the development of a new poultry value chain enterprise in charge of managing a poultry value chain enterprise with share participation of the public sector in this case (NIRDA), the private sector and producers. In order to identify potential partnerships between private and producers, NIRDA technical and business plans service providers will act as facilitators, identifying the most suitable candidates and promoting/supporting these partnerships.

This approach will certainly promote the role of the private sector which will be the driver of improved efficiency and increased poultry value chain investments. An increased number of private companies will be engaged in PVC handling, processing, marketing and trading of farm outputs. At the same time, the co-financing process will determine an increased access to PVC extension network, infrastructure, markets and financing demonstrating their reliability and creating a sense of empowerment whose effects will spread far beyond ensuring sustainability.

3: Cooperative LED (NIRDA/Cooperative) in the construction of a new infrastructure (Poultry Slaughter houses and Feed processing plant)

In this approach a co-investment will be made either between the NIRDA and cooperative in a new infrastructure. This approach will either promote the positive involvement of the private sector or large scale commercial poultry enterprise who cannot afford to set up the required regulated and standard poultry hatchery, modern slaughter house and or poultry processing plant with international standards infrastructures through financial institutions due to the lack of enough funds/guarantees.

This approach will either promote the involvement of the private sector or support those PVC who cannot afford to set up PVC infrastructures through financial institutions due to the lack of enough funds/guarantees.

The primary target group of the NIRDA call for proposal will be PVC actors (large scale commercial poultry farmers, Poultry product and by-product processors, Hatcheries, transporters and Agra-dealers). The development outcomes of the 4Ps model will include:

The above poultry Value chain actors' productivity and supply of quality poultry products to domestic and regional markets enhanced and products consumption level increased;

Poultry value chain organizational capacity and enterprise skills enhanced;

Upgrading infrastructural and technological capacities and adoption Poultry housing, Incubators, automatic feeding and watering systems, collection, handling, processing and marketing of poultry products expanded and its utilization improved and tailored to adverse climate resilience;

A conducive policy and institutional environment for the development of PVC industry fostered and strengthened through the establishment of poultry feed and hatchery production units.

Strategies for implementable of 4Ps model

First, the service providers will define its objectives, roles and responsibility i.e. from the identification and selection of 4P partners (both producer's cooperatives and PVC enterprises) to the development of a joint business plan, to the negotiation of contractual arrangements related to the joint management of assets and delivery of products, to the actual monitoring of its execution and results. It should be noted that the private PVC sector companies are struggling with the lack of consistent (both in quantity and quality) sourcing of products for processing and/or marketing.

Second, the model will promote the engagement in a long-term partnership with suppliers which is seen as a way to better control the quality of the produce and make sure producers have all necessary means deliver the agreed volumes. Private companies may also facilitate access to inputs through in-kind credit arrangements or by helping farmers to get loans from financial institutions as well as provide specialized technical assistance through NIRDA field staff, the development of a joint business plan, to the negotiation of contractual arrangements related to the joint management of assets and delivery of products, to the actual monitoring of its execution and results.

NIRDA Staff in collaboration with Service providers will undertake a quick mapping of PVC supported value chains to scout for private PVC enterprises interested in the 4P approach as well as, based on hub classification prepared by NIRDA, identify suitable producer's cooperatives or farmers.

Table 19: Checklist of required documents on NIRDA supported business plans through BDF

No	1. Private Led business BPs (Individuals or Company)	2. Cooperative led	3. Joint venture
1	Clear and signed Identification form by NIRDA and business plan	Clear and signed Identification form by NIRDA and business plan	Clear and signed Identification form by NIRDA and business plan development service provider

	development service provider	development service provider	
2	Valid Bills of Quantities (Bear stamp and Certificate of Engineer) authorized by RDB and registered in the Rwanda Institute of Engineers	Valid Bills of Quantities (Bear stamp and Certificate of Engineers) authorized by RDB and registered in the Rwanda Institute of Engineers	Valid Bills of Quantities (Bear stamp and Certificate of Engineer) authorized by RDB and registered in the Rwanda Institute of Engineers
3	Designs and Perspectives approved by relevant District Authorities	Designs and Perspectives approved by relevant District Authorities	Designs and Perspectives approved by relevant District Authorities
4	Land title for construction sites (characterized with UPI)	Land title for construction sites (characterized with UPI)	Land title for construction sites (characterized with UPI)
5	Environmental impact assessment (EIA) in case of processing plants)	Environmental impact assessment (EIA) in case of processing plants)	Environmental impact assessment (EIA) in case of processing plants)
6	RSB Certificate for the existing processing plants that need equipment's, extension, innovation etc	RSB Certificate for the existing processing plants that need equipment's, extension, innovation etc	RSB Certificate for the existing processing plants that need equipments, extension, innovation etc
7	Three Proforma invoices and catalogue for any moveable asset to be supported by NIRDA GRANT	Three Proforma invoices and catalogue for any moveable asset to be supported by NIRDA MG	Three Proforma invoices and catalogue for any moveable asset to be supported by NIRDA MG
8	-Promoter’s ID -Joint venture Company Registration Certificate -RCA certificate of contracted cooperatives. ID of Private Promoters	RCA certificate -ID cards of Committee	-Company Registration Certificate. -Promoter’s ID
9	In case of loan: loan notification letter and loan contract	In case of loan: loan notification letter and loan contract	In case of loan: loan notification letter and loan contract
10	-signed minutes of the shareholders to apply for the grant in case of more than one shareholder	Signed meeting minutes of general assembly and list of participants	-signed contract of Joint venture activities by both parties -Signed minutes of the cooperative to join a joint venture BP

11	Valid Construction permits (Poultry house & Other construction activities) signed by authorized District authorities	Valid Construction permits (poultry house& Other construction activities signed by authorized District authorities	Valid Construction permits (Poultry house& Other construction activities signed by authorized District authorities
12	Signed contracts of potential buyers or sellers of the product (Any Market contract of the intended product under the support of NIRDA	Signed contracts of potential buyers or sellers of the product (Any Market contract of the intended product under the support of NIRDA	Signed contracts of potential buyers or sellers of the product (Any Market contract of the intended product under the support of NIRDA
13	Contract with the cooperative which will benefit from the grant through Private led BP where applicable		Joint venture Contract between the company and the cooperative
14	Joint Field Visit report signed by NIRDA Field staff and BDF in the concerned District	Joint Field Visit report signed by NIRDA Field staff and BDF in the concerned District	Joint Field Visit report signed by NIRDA Field staff and BDF in the concerned District
15	Business plan signed by the Promoter and stamped in case of private company	Business plan signed by the Promoter and stamped	Business plan signed by the Promoter and stamped
16	Beneficiary's application letter addressed to CEO - BDF and stamped in case of a cooperative or a company	Beneficiary's application letter addressed to CEO - BDF and stamped in case of a cooperative or a company	Beneficiary's application letter addressed to CEO - BDF and stamped in case of a cooperative or a company
17	Any other supporting documents upon request	Any other supporting documents upon request	Any other supporting documents upon request

	depending on the category of the intended business plan	depending on the category of the intended business plan	depending on the category of the intended business plan

Table 20: Details on 4Ps-Model to be used for PVC value chain financing

Type activities to be funded	**Sources of funding**	**% Project contribution/NIRDA**	**Ceiling Project contribution**
I. Private agribusiness-led Business Plan			
Eligible grantees	**Private enterprise having contractual relations altreast 20 Farmers or cooperative / PPCC(Poultry Product Collection center)**		
Investments on: - Marketing and processing infrastructure and equipment for increased milk collection, storage and value addition - Animal feed	- Private sector own resources (equity) - Loan from FIs	Up to 70% of total investment	USD 500 per coop member engaged in contractual relationship with a maximum amount of USD 100,000
Capacity building for private enterprise (e.g. quality standards, certification from RSB)	Private sector own resources	Up to 50%	USD 5,000
Capacity building of Coop or Farmers / PPCC on technical (extension), organizational (e.g.coop governance) and management (e.g. accounting, business planning, marketing) issues	Coop own resources	Up to 80%	USD 10 000
II. Cooperative led business plan			
Eligible grantees	**Cooperative along the dairy value chain (PPCC,FARMERS , animal feed, veterinary services, …)**		
Investments on processing infrastructure and equipment for storage and value addition	- Coop own resources (equity) - Loan from FIs	Up to 80%	USD 500per coop member engaged in contractual relationship with a maximum amount of USD 100,000

Capacity building for the coop to manage the infrastructure (e.g. quality standards, certification from RSB) Capacity building on technical (extension), organisational (e.g.coop governance) and management (e.g. accounting, business planning, marketing) issues	Coop own resources	Up to 80%	10,000 USD
Investments on 4P private sector partner's assets (e.g. transportation, inputs distribution)	- Private sector own resources (equity) - Loan from FIs	Up to 50%	5, 000 USD
Capacity building for private sector (e.g. quality standards, certification from RSB)	Private sector own resources	Up to 50%	5, 000 USD
III. Joint venture between producers' coop(s) and private sector			
Eligible grantees	**Coop / PPCC and private sector enterprise**		
Joint investments on processing infrastructure and equipment for storage and value addition	- Coop own resources (equity) Loan from FIs - Private sector own resources (equity) - Loan from FIs	Total grant Max 60% Up to 40% for Coop Up to 20% for private sector	USD 200 per coop member engaged as shareholder and in contractual relationship with a maximum of 200 000 USD
Capacity building to manage the infrastructure (e.g. quality standards, certification from RSB) Capacity building on technical (extension), organizational (e.g.coop governance) and management (e.g. accounting, business planning, marketing) issues	Coop own resources Private sector own resources	Up to 80% for coop Up to 50% for private sector	10, 000 USD 5 000 USD
V. Grant for climate smart and strategic investments			
Eligible grantees	**Cooperative and SMEs in production, marketing, processing and services**		
Rainwater harvesting systems (Solar system, biogas, etc.), Waste water management and treatment systems at PPCC, Poultry processing plants, poultry houses, hatchery premises, feed processors equipment washing facilities	- Coop or SMEs own resources (equity) - Loan from FIs	Up to 60% of total capital investment	100,000 USD

associated with solar water heater, climate proof components, with clear climate risk management plan			
VI. Grant for innovation, youth and women			
Investments for Youth /Women innovations in Poultry Vaue chain Enterprise : . Intensified Poultry production using climate smart technologies, . Poultry value addition and processing, . Innovations in inputs and equipment, . Innovations in farm management ICT tools, . Innovations targeting market expansion and new consumers creation	- Enterprise or coop own resources - Loan from FI	Up to 80% of total investment	10 000 USD for individual enterprise 20 000 USD for cooperative
Capacity building depending on business nature	- Enterprise or coop own resources	Up to 80%	5 000 USD

5.1.3 Established Center of Excellence

NIRDA should establish the poultry value chain center of excellence will offer more scientifically robust based PVC appropriate and standardized technologies to PVC actors all under one roof sets the new state of the art poultry. The Center of Excellence for Poultry Science comprises the following facilities: Poultry standard licensed procedures for PVC actors, PVC technology teaching department; A poultry research farm facility

5.2 Conclusions

Due to government enabling policy environment especially VAT and income tax exemptions,

1. A number of poultry businesses such as commercial poultry farmers, feed processors, hatcheries and agro-dealers have sprung up throughout the country. However, the number and size of these poultry business is still and comprises of only small and medium enterprises
2. The level of adoption and use of the improved technologies in poultry farming in low. Most commercial farmers use poor poultry houses without feeding and watering system, poor ventilation, poor waste disposal, no eggs collection/processing and poor bio-security measures.
3. The hatcheries are not fully operational due to both less working capital and low demand for DOCs, are dependent on importation of hatching eggs hence supply of DOCs is irregular and costly.
4. There are many un coordinated stakeholders resulting into role confusion and hence no one seems to be in charge.

5. Feed processors operate under capacity because of inadequate supply of raw materials, low demand due to a small number of commercial poultry farmers and together with costly imported raw material ingredients leads into production of expensive feeds.
6. Provision of veterinary services both from both private and public veterinary services providers is limited.
7. Other poultry value chain actors such as agro-dealers/veterinary drugs, transporters, meat and eggs sellers are engaged in other businesses
8. The poultry products-meat and eggs are on demand but they are not competitive on the market. The cost of inputs is the main factor driving the cost of doing business high.
9. The major constraint to all poultry value chain actors is lack of adequate capital to adopt and use improved technologies. Other constraints include lack of managerial and technical skills.
10. Marketing including lack of market infrastructure and branding is a serious constraint to commercial poultry farmers.

5.3 Recommendations

Recommendations with regard to the poultry value chain are summarized in table below.

Table 21: PVC challenges, recommendations and responsible

PVC Challenges	Recommendations	Responsible
Lack of specialized skills/low technology uptake, poor regulatory standards	Establish Poultry Provincial Center of Excellence	PSF/RPIA/RAB/NIRDA/RSB
Lack of standard poultry housing systems. Most commercial farmers generally do not use modern poultry housing system and this affects the quality of meat and eggs, and reduces chances of accessing premium prices and export markets.	There is a need to put in place national regulatory poultry housing standards for poultry farmers. There is a need to put in place practical and actionable implementation procedures and monitoring tools and enforcement procedures to ensure the regulatory standards are in place and full enforced. Promote and support the adoption of improved housing practices and labor-saving techniques for chicken farming this will reduce mortality, predation this will positively impact poultry production.	RAB/MINAGRI/RPIA
Low level of adoption and use of the improved technologies in poultry value Chain.	Apply 4 Ps Model. The public, private and producer partnership (4Ps) model is a project financing model which allows poultry value chain to be financed jointly by several actors involved in PVC, namely the private who buys and sells the production, the poultry farmer and the public sector which supports	

	the value chain of that production. 4Ps model allows putting in place all necessary measures to control and making a close follow up of each step of investment, and render the beneficiary more accountable to the use of grant. Establishment of the Center of Excellence which will strengthen technological capacities of PVC actors.	BDF/RAB/PSF/RPIA/ NIRDA andFIs/MFIs
The hatcheries are not fully operational due to Low capacity of incubators; poor capacity to meet farmers demands; Hatchery companies lack parent stock and often relay on imported fertilized eggs and Inadequate technical skills and financial capacity as well irregular supply and costly DOCs.	The study recommends the strengthening the existing hatchery companies and through 4 Ps model.	BDF/RAB/PSF/RPIA/ NIRDA andFIs/MFIs
Feed processors operate under capacity because of inadequate supply of raw materials and together with costly imported raw material ingredients leads into production of expensive feeds.	The study recommends contract farming system between feed processors and poultry feed ingredient growers and suppliers in order to solve the problem of imported ingredients. Feed processors should establish large scale stocking system that would accommodate stock during harvest time. RSB should enforce the existing poultry feed processing standards. Feed processors and feed distributors (agro dealers) should be supported quality and timely services to poultry farmers.	RAB/PSF/RPIA/RSB/ MINICOM/NIRDA/FIs
The poultry products (meat and eggs) are of high demand but they are not competitive on the market. The cost of inputs is the main	Operationalize and enforce the existing regulatory standards of poultry production, processing and transport to ensure poultry products meet the standards that are required by the market (local and international).	PVC operators/Input providers/RPIA/RSB, RAB, RICA/MINICOM/NIRDA

factor driving the cost of doing business high compared on regional poultry products.	Promote and support the establishment of contract between PVC operators and their input suppliers/providers with arrangements for local supply and to comply with the quality standards.	
Marketing organization, market infrastructure and branding are serious constraint to commercial poultry Value Chain actors.	Support the development of information systems providing value chain actors with latest market trends and other relevant news, through all available systems e.g radio or mobile phones. Develop new partnerships between actors to improve collection and aggregation of PVC products via poultry product collection centers (PPCCs) at district levels allowing remote farmers to send products to urban centers. Organize multi-stakeholder meetings and sessions, business roundtable and networking. Assist the creation, reinforcement or expansion of the organization of PVC and actors in the value chain.	MINICOM/PSF/RAB/ Districts/RPIA/PVC actors
Weak RPIA coordination of the PVC actors	Assist RPIA to develop of appropriate strategy that support and promote the organization and coordination of value chain actors in an inclusive manner, allowing them to make their voices heard at a national and regional. There is a need to overhaul the association so that it is able provide advocacy and promote the poultry sector to a more competitive and profitable enterprise. This will help small-scale producers and actors to band together to address their concerns and participate in the development of policies that support PVC.	MINAGRI/RAB/PSF/ PVC actors
Lack of poultry value chain technical and specialized skills	There is a need develop PVC specialized skills needs assessment for PVC actors. There is a need to develop PVC specialized skills curriculum or hands-on training modules for each PVC actor based on outcome from the skills assessment.	

	There is a need to disseminate the specialized content to PVC actors in a timely manner. Provide support to strengthen the extension services by private actors in the value chain. Train facilitators to conduct a farmer field school cycle to increase their capacities in various thematic areas through continuous farmer field school cycles.	RAB, RPIA, NIRDA with support of development partners.
Poor extension and veterinary services delivery to PVC and poor supply for vaccines and essential veterinary drugs to PVC actors	The study recommends MINAGRI/RAB to task and strengthen the capacity of Rwanda Council of veterinary doctors (RCVD) to continuously provide quality, affordable and reliable veterinary services for poultry farmers' particularly rural based farmers. RAB should set up a coordination mechanism for both private and public extension and veterinary service providers with the main objective of to continuously provide quality, affordable and reliable veterinary services to poultry farmers particularly rural based farmers.	RAB/RCVD/RPIA/Districts
Like the other sub-sectors in agriculture, the poultry industry is constrained by lack of capital investment. Conventional financial institutions are reluctant to provide loans to farmers thus limiting investment in PVC.	Facilitate the financing through 4Ps (Public, Private, producers Partnership) model. Establishment of access to finance scheme combining a system of guarantees from BDF, grants from NIRDA and credit facilities from credit banks Provide capacity-building and financial literacy and training to PVC actors. Facilitate the adoption of insurance systems (e.g. disease -based insurance schemes).	NIRDA, RAB, BDF
Regional competition with similar products from the region is a big threat to the industry as the regions continues to produce cheaper	There is a need to strengthen national regulatory poultry production and housing standards for poultry farmers to meet regional quality standards. There is a need to put in place conducive environment for capital investment in PVC	

poultry products.	actors. Assist the development of trans boundary agreements relative to the movement of PVC products.	 NIRDA, RAB, PSF
Weak poultry sector regulations, standards and certification	Increase awareness raising and capacity building regarding standard requirements and compliance to PVC actors. This will help PVC actors understand how and why to comply with standards. Increasing consumer awareness on food quality and health; Support capacity building for testing compliance and certification to specific standards. This will promote competitiveness and trust is increased towards product quality; accountability is improved. Facilitate the adoption of voluntary standards (certification, accreditation, labeling etc.) by value chain actors, with a specific focus (e.g. protected designation of origin [PDO], ISO 14000). Facilitate the adoption of trace-ability systems and mandatory health standards to promote access to export markets.	RAB/MINAGRI/RSB

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Annexes

Annex 1. Questionnaire for technology audit of commercial poultry farmers

Section 1: General Information

1. Identification and address

Interviewee Name	E-mail	Tel.	Province	District	Sector	GPS	Work experience	Enumerator Name

2. What is your highest level of education?

a. Completed Primary education
b. Secondary school certificate
c. Bachelor's degree
d. Master's degree/PHD
e. Other (specify)

3. Legal Status

Sole Proprietorship	Limited by shares	Limited by guarantee	Limited by shares and guarantee	Unlimited	None
1	2	3	4	5	6

4. Firm's ownership Composition

Ownership shares	Foreign	Private	Public Government

Section 2: Farm human resources and skills assessment

5. How many employees does farm have?

No	Range size	Ratio of males to females	Ratio of youth to adult employees
1	1 to 3 employees		

2	4 to 30 employees		
3	31 to 100 employees		
4	Above 100 employees		

6. Employees' skills assessment

Source	Number of employees	Number of employees with a university degree	Number of employees with a technical school degree	Number of employees other types of degrees	Number of employees who received further trainings/short courses in relation to the job	Comments
Permanent staff						
1. Supply/raw material reception						
2. Farm management						
3. Quality control						
4. Marketing and sales						
5. Administration						
6. Other (specify)						
Casual workers						

Section 3: Poultry farm design, management and technological capabilities

7. Does your farm have enough space for production and the ability to extend in the long run?

	Tick what applies	Comments if any
Yes		
No		
Don't know		
Space ownership		
Own space		
Rented space		
Other (specify)		

8. Poultry housing system and motivations for adoption

Housing system	Number of houses/system	Motivations for adoption
1. Deep litter		
2. Cage system		
3. Mixed system		
4. One tier house		
5. Two tiers house		
6. House constructed with traditional materials		
7. House constructed with modern materials		
8. Other (specify)		

9. What type of poultry houses does have your farm? (tick all that apply)

a. Open house

b. Partially closed house

c. Closed house

d. Other (specify)

10. Does the poultry house meet all the standard requirements? (Tick all that apply)

a. Stocking density (standard= 5layers/m2, 7-10broilers/m2): a. Yes, b. No

b. Sufficient natural lighting (Area for windows is of 1/10 of floor space area): a. Yes, b. No

c. Adequate aeration (windows with wire mesh): a. Yes, b. No

d. Deep litter system with minimum of 5kg of litter/m2: a. Yes, b. No

e. Cage system with well designed cages: a. Yes, b. No

f. A pit for farm waste management is in place: a. Yes, b. No

g. A footbath filled with disinfectant solution is set up at each house entrance: a. Yes, b. No

h. Other (specify)

11. Connectivity of the farm to basic infrastructures /facilities and motivations for adoption

Infrastructures	Source/or distance to road (km)	Motivations
Electricity		
Water		
Main road		
Other (specify)		

12. Technological capabilities levels of the farm (tick all that apply and motivate the choice)

	Technology	Reasons for adoption or not

In-house water supply to chickens	1. Manual 2. Semi-automatic 3. Automatic	
In-house feed supply to chickens	1. Manual 2. Semi-automatic 3. Automatic 4. Other (specify)	
Eggs collection and sorting by size	1. Manual 2. Automatic	
Heating in brooder house	1.Traditional brooder (use of charcoal) 2.Modern brooder (radiant or infrared lamps)	
Debeaking	1.Debeaking machine	
Waste disposal	1. Manual 2. Mechanical	
Chickens processing (if any)	1. Manual 2. Machine processing (slaughter only) 3. Machine processing (slaughter and cutting)	
Other (specify)		

Section 4: Feeding management

13. Type and source of feeds and motivations for choice of source (tick all that apply)

Types of feeds	Sources	Motivations
Broilers	a. Homemade	a.
Layers	b. Feed Processing plant	b.

	c. Small scale feed processor d. Other (specify)	c. d.

14. Chickens' feeds prices

Types	Unit cost	Total cost/year
Feed ingredients (specify)		
Layers feeds		
Broilers feeds		
Other feeds		

Section 5: Genetics of chickens

15. What is the genetics and source of your chickens?

Genetics of chickens	Breed/or strain name	Source of DOCs (specify)	Purchase cost (FRW)/DOC
Commercial layers			
Commercial broilers			
Dual-purpose chickens			
Other (specify)			

16. Population size of chickens per type

Chickens genetics	**Breed/or strain**	**Number**
Layers		
Broilers		
Dual-purpose		
Other (specify)		

Section 6: Diseases management

17. Is the vaccination programme applied in your farm?: a. Yes, b. No

18. If No, what are the reasons for non application? (Specify)

19. Types of vaccines used in vaccination programme for broiler, layer and dual-purpose chickens (specify the period of administration of the vaccine)

Vaccines against the following diseases:	Layers	Broilers	Dual-purpose chickens
Marek			
Gumboro			
Newcastle			
Fowl pox			
Infectious Bronchitis			
Other (specify)			

20. Is the medication programme applied in your farm? a. Yes, b. No
21. If no, what are the reasons for non application? (Specify)
22. Types of drugs/medicines, disinfectants used and their names in layers, broilers and other chickens reared

Types	Layers	Broilers	Other chickens
1. Antibiotics			
2. Antheminthics			
3. Coccidiostats			
4. Antistress			
5.Disinfectants			
6. Other (specify).			

23. Other disease control/or biosecurity measures applied (specify):…………………………..
24. Chickens mortality with regard to their stage rearing

a. Mortality rate in broilers

Chickens	Brooding stage (0-2weeks) Mortality (in %)	Growingstage (2-3weeks) Mortality (in %)	Finishing stage (3wks-slaughter age) (Mortality in %)	Total mortality (%)
Broilers				

b. Mortality rate in layers

Chickens	Brooding stage	Growing stage	Laying stage	Total

	Mortality (%)	Mortality (%)	Mortality (%)	mortality (%)
Layers				

c. Mortality rate in dual-purpose chickens and others

Chickens	Brooding stage Mortality (%)	Growing stage Mortality (%)	Laying stage Mortality (%)	Total mortality (%)
Dual-purpose				
Other (specify)				

25. Extension and veterinary services received

a. Extension services

i) Availability: a. Yes, b. No,

ii) Provider: a. MINAGRI/RAB, b. NGOs (specify), c. RCVD, d. Other (specify) iii) Total annual cost estimate (in FRW) (specify)

b. Veterinary services

i) Availability: a. Yes, b. No

ii) Provider: a. Public vets, b. Private vets, c. other (specify)

iii) Total annual cost of vet services (in FRW) (specify)

Section 6: Farm productions, records, markets and marketing and farm profitability

26. What records do you keep in your farm for layers and broilers? (Give the figures)

Records keeping in layers	**Records keeping in broilers**
1. Age at start of lay(weeks) (standard=5months)	1. Feed intake (0-42days=4kg)
2. Age at peak of lay (weeks) (standard=25-35weeks)	2. Growth rate (0-42days=32-55g/d)
3. Egg size (in g)	3. Feed conversion ratio (broilers ‘average feed intake, g/broilers average body weight, g; standard=1.82-2.5)
4. Hen-egg production rate	4. Production cycle length (in days) (standard=60days)
5. Feed Intake (1-4.5months=7kg, 4.5months—17months=45kg)	5. Number of production cycles /annum (standard=6)

6. Feed conversion ratio (feed intake, g/eggs laid, g)	6.Number of produced broilers/annum(depends on # houses)
7. Laying period length (months) (standard=12months)	7. Production cost in FRW/kg of broiler (Total expenses/Total kg of broilers at slaughter age)
8. Production cost/egg (Total expenses/#eggs laid)	8. Dressing percentage (or carcass yield) = average broilers 'carcass weight (Kg/ average broilers 'body weight (kg) x 100 (standard=68-70%)
9. Mortality rate (standard=3-5% in rearing stage and 0.5%/month in laying period)	9. Slaughter age (standard=42-49days)
10. Culling age (standard=72weeks)	10. Mortality rate (standard=3-5%)
11. Water Intake at 250C= Feed x 2.4	11. water Intake= Feed x 2.1
12. Other (specify)	12. Other (specify)

27. Broiler farming and production in the last 3 years

Year	Length ofproduction cycle (in days	Number of production cycles/year	Number of broilers produced/year
2019			
2018			
2017			

28. Layer farming, number of chickens and egg production in the last 3 years

Year	Laying period (months)	Number of layers/year	Eggs laid/year	Average annual hen-day egg production rate
2019				
2018				
2017				

29. Other chickens' production in your farm (specify):………………………

Year	Type of production	Unit cost(FRW)	Volumes (Tons)	Values (FRW)
2019				
2018				
2017				

30. Farm production capacity and information sale in

No	Products description	Quantity per year	Unit Price (FRW)	% sold on local market	% sold on international market
1					
2					

31. Poultry products markets/major products destination in last 3 years (market share in %)

Year	Local Market	Regional	Other	Market share in %
2019	1. 2. Etc	1. 2. Etc.		
2018	1. 2. Etc,	1. 2. etc.		
2017				

32. Do you have market competitors?

	Tick all that apply	Comments
Local competitors		
Regional competitors		
International competitors		
No competitors		

32. If No, what prevents you from competing favourably?
33. If yes, what strategies can you put in place to compete favourably?
34. Estimation of broiler farm profitability

Expenses (FRW/year)	Income (FRW/year)	Profitability/Loss
Variable costs (FRW)		
1. Purchase of DOCs 2. Feeds cost 3. Energy for heating the brooder house 4. Fuel for transportation e. Litter cost f. Drugs and vaccines costs	1. Meat sale/annum 2. Live broilers sold /annum 3. Manure sale /annum	Income >Expenses= profit Income<Expenses=loss

Fixed costs (FRW)		
1. Depreciation of house over 10years, 2. Depreciation of equipment over 5years, 3. Interest on loans granted		
Total Expenses (FRW **(Variable + Fixed costs)**		

35. Estimation of Layer farm profitability (data collector will assist the farmer for calculation)

Expenses (FRW/year)	Income (FRW/year)	Profitability/Loss
Variable costs (FRW)		
1. Purchase of DOCs 2. Feeds cost 3. Energy for heating the brooder house 4. Fuel for transportation e. Litter cost f. Drugs and vaccines costs	1 Eggs sale 2. Culled layers sale 3. Manure sale	Income >Expenses= profit Income<Expenses=loss
Fixed costs (FRW)		
1. Depreciation of house over 10years, 2. Depreciation of equipment over 5years, 3. Interest on loans granted		
Total Expenses (FRW)= Variable + Fixed costs		

36. What are the types and sources of farm inputs in layers? (Tick all that apply)

Poultry farm inputs	Source/Supplier firm	Comments
Medicines		

Vaccines		
Disinfectants		
Feeds		
Drinkers		
Brooders (heaters)		
Nest boxes		
Egg storage facility (specify)		
Extension services		
Cages		
Litter		
Day-old-chicks		
Other (specify)		

37. What are the types and sources of farm inputs in broilers? (Tick all that apply)

Poultry farm inputs/services	Source/Supplier firm	Comments
Medicines		
Vaccines		
Disinfectants		
Feeds		
Drinkers		
Brooders (heaters)		
Extension services		
Cages		
Litter		
Day-old-chicks		
Other (specify):....		

38. What are the types and sources of farm inputs in other chickens? (Specify andTick all that apply)

Poultry farm inputs/services	Source/Supplier firm	Comments
Medicines		
Vaccines		
Disinfectants		
Feeds		
Drinkers		

Brooders (heaters)		
Extension services		
Cages		
Litter		
Day-old-chicks		
Other (specify):....		

Section 7: Farm's source of financing

39. Please give the financing status of the farm (in FRW) for the last three years as a share of the total financing

Year	Foreign financial institutions (FRW)	Domestic financial institutions (FRW)	Shareholders (FRW)	State/government loans (FRW)	Total financing (FRW)
2019					
2018					
2017					

40. What constraints do you face in poultry farming in general?
41. What strategies would be put in place to upgrade efficiency in you farm?
42. How do you access to market and market information?
43. What was the initial capital investment when you started your poultry firm?
    a. Less than 500,000FRW
    b. Between 500,000 FRW and 15 million FRW
    c. Between 15 million and 75 million FRW
    d. Above 75 million Frw
44. Which of the following books do you use for accounting?
    a. Journal
    b. Cash book
    c. Ledger
    d. Sales book
    e. Debtor book
    f. Creditor book
    g. Inventory
    h. Profit and loss
    i. Balance sheet
    j. Other (specify)

45. What percentage of the business did you own when the business started?

Percentage owned	Percentage contributed by Bank loan	Percentage contributed by other shareholders/family
----------------------%	------------------------%	----------------------- %

46. Did you experience any obstacles shortly after establishing your poultry firm?
    a. Poor cash flow management
    b. Poor monitoring and control
    c. Poor communication
    d. Company organization
    e. Poor record keeping
    f. Financial constraints
    g. Inadequate technology
    h. Other (specify)
47. What were the problems with getting access to finance for your poultry firm?
    a. Lack of collateral
    b. Loan maturity terms
    c. Getting loan guarantee
    d. Development of business plan
    e. Commission and other extra payment
    f. Submission of the required papers
    g. High interest rate
    h. Other (specify)

48. What is your current operational status?
    a. Fully operational
    b. Partially opened
    c. Other (specify)

49. To what extent do you conduct your business in accordance to your business plan?
    a. Completely
    b. Partially
    c. Fairly
    d. Not at all

50. What are the main obstacles for your poultry firm?
    a. Shortage of inputs/technological assets

b. Sales
c. Access to finance
d. High cost of rent
e. Disruption of supply chain
f. Frequent inspections by state bodies
g. Availability of qualified labour force
h. Condition of local infrastructure
i. Cost and quality of utilities (water, electricity,)
j. Other (Please specify

51. What are your poultry firm's Managerial and Financial Factors

Statements	**Rankings**						Please note
	1	**2**	**3**	**4**	**5**	**6**	
							1=Very low influence 2=Low 3=Moderate influence 4= High influence 5=Very high influence 6= Have no idea influence
Ineffective and inefficient communication with customers, suppliers, or other outside organizations may contribute to the business failure							
The absence of or poor financial planning							
Less capital contribute to the failure of business							
The absence of financial records							
Lack of financial management skills							
Lack of leadership and human resource management skills							
Lack of risk management skills							
Lack of technical and business education							
Lack of IT management skills							
Lack of technical asset and their management skills							
Lack of skill to identify and prioritize the problems and opportunities							

Lack of adequate knowledge and access to public information on policies and programmes							
Lack of knowledge to require funding from financial institutions							
Lack of experience and lack of confidence in running the business							
Lack of creativity and innovation							
Customers' failure to pay their debts							
Poor participation in the policy making process							
Other (specify)							

52. How do you access to market and market information?

a. Market Competition as Failure Factors

Statements	**Rankings**						Please note
	1	**2**	**3**	**4**	**5**	**6**	
Lack of marketing knowledge may contribute to the business failure							1= Very low influence 2=Low influence 3=Moderate influence 4= High influence 5=Very high influence 6= Have no idea
Lack of competitive advantage over competitors							
Disregarding customer complaints may contribute to the failure of business							
Setting a lower or too expensive competitive price of goods							
Negligence to cultivate product awareness							
Lack of strategies about customer acquisition							
Lack of strategies about customer retention							
Lack of value proposition where your product offers a higher level of value than your competitors							
Lack of or have limited access to credible							

markets (local and regional and international market)							
Lack of knowledge about packaging and labeling locally made products							

b. Incontrollable Factors as Failure Factors

Statements	Rankings						Please note
	1	**2**	**3**	**4**	**5**	**6**	
Long process of import clearance and goods handling at MAGERWA warehouse							1= Very low influence 2=Low influence 3=Moderate influence 4= High influence 5=Very high influence 6= Have no idea
Disruption of supply chain may lead the							
Rising in taxes or High taxes constraint							
Inadequate infrastructure conditions where the business is located							
Fast rising prices or cost of renting commercial/store space							
Shortage of skilled people							
Inadequate supplying of water and electricity in the area may increase the operations cost							
The whole set of strict procedures in licensing the business in pre-start-up stage consumes all the money							
High interest rate on acquiring loan charged by commercial bank							
High penalties or high level of fines charged by government in case of failure to comply with policies or tax evasion or fraud							
Mentality of customers with passion of external products where businesses with locally made products face a high level of international (China, India, Dubai, etc.) and EAC regional competition							
The absence of agencies, schools or training centers to support in knowledge and skills							

development in the area							

Annex 2. Questionnaire for technology audit of poultry products & by-products processors

Section 1: General information

1. Location and date of interview

Interviewee Name	E-mail		Tel.	Province District	Sector	GPS	Date	Work experience	Enumer. Name

2. What is your highest level of education?

a. Completed Primary education
b. Secondary school certificate
c. Bachelor's degree
d. Master's degree/PHD
e. Other (specify)

3. Legal status of the firm

Sole Proprietorship	Limited by shares	Limitedby guarantee	Limitedby shares and guarantee	Unlimited	None
1	2	3	4	5	6

4. Firm's ownership Composition

	Foreign	Private	Public Government
Ownership shares			

Section 2: Human resources and skills assessment

5. Human resources: qualifications and training

Source	Number of	Number of employees	Number of employees	Number of employees	Number of employees

	employees	with a university degree	with a technical school degree	other types of degrees	who received further trainings/short courses in relation to the job
Permanent staff					
Supply/raw material reception					
Poultry egg and meat processor					
Poultry by-products processor					
Quality control					
R & D					
Marketing and sales					
Administration					
Other (specify):………..					
Casual workers					

6. Types of continuous training offered to employees

Area of training	**Yes**	**No**	**None**
Good poultry processing Practices			
Operating processing machines			
Product development			
Other:			
Food quality and safety related			
Food hygiene			
Food safety systems (HACCP,			

ISO22000, etc)			
Other:			
Economy/finance/administration/marketing			
Accounting			
Marketing			
Administration			
Other areas (specify)			

7. If no continuous training was offered, what are the reasons?

	Tick all that apply	**Comments**
Training high cost		
Lack of training providers		
Insignificant needs for additional training		
Enough internal training		
No resources allocated for training		
Other (specify)		

Section 3: Poultry meat processing equipment, volumes of products, markets and marketing

8. What is the source of processed chickens in your plant?

a. Own broilers and culled layers

b. Chickens from others (mention the fees charged/chicken slaughtered)

9. Is your plant equipped with separate rooms for the following stages of processing? (Tick all that apply)

a. reception of birds,
b. slaughter, scalding and defeathering
c. evisceration, washing and giblet processing
d. chilling
e. cutting and packing
f. freezing and storage

g. dispatch
h. by - product processing
i. 0ther (specify)

10. Is your plant equipped with the following facilities? (Tick all that apply)

a. Offal Room
b. Staff facilities (changing areas, toilets, showers, washing facilities, lockers and bins for dirty laundry)
c. Hand and Boot Wash
d. Laundry
e. Offices
f. Inedible by-Products and Waste Disposal Facilities: solid by-products (feathers, blood, viscera, feet, head and trim) and effluent (from birds droppings, blood, wash-down of the dry-plucked bird, wash-down of the plant and staff facilities)

11. What types of machines does your firm use and mention their sources (Tick all that apply)

Types of machines	**Capacity (# or kg birds/day)**	**Source**		**Comments**
		Made in Rwanda	**Imported**	
Slaughter				
Scalding				
Defeathering				
Washing				
Giblets processing				
Chilling				
Cutting				
Packing				
Other (specify):................				

12. Do you have any challenges for accessing the processing machines?

13. How would these challenges be solved?

14. What are the volumes and values of processed chickens in the last 3 years?

Slaughtered Chickens	2019	2018	2017

	Volume (kg)	Value (Frw)	Volume (kg)	Value (FRW)	Volume (Kg)	Value (FRW)
Broiler						
Culled layers						
Other (specify)						

15. Markets for processed chickens (mention the main clients /year)

Year	Individuals	Hotels	Restaurants	Food shops	Other (specify)
2019					
2018					
2017					

16. Processed products' sales information

Products	**Unit cost**	**Volumes (kg/tons)**	**Value (FRW)**	**Estimated share of total sales (%)**
1.				
2.				
3.				
Other (specify)				
Total				

17. What are your main marketing strategies?

Marketing strategies	**Tick all that apply**	**Comments if any**
1. Trade regulations (From RRA and RDB)		
2. Dominance in marketing		
3. Through innovations		

4. Under growth strategies		
5. Advertisement and promotions		
6. Other: Specify		

18. Products' markets shares (%): Indicate the major products' destination markets for the last 3 years

Market shares in %		
Year	**Local market**	**Regional market**
2019		
2018		
2017		

Section 4: Chickens Eggs and By products processing

19. Does your firm involve in eggs processing?
a. Yes
b. No
20. If No, what are the reasons?
21. If Yes, What are the products made from eggs in your firm? a. Mayonnaise
b. Cakes
c. Bread
d. Chapati
e. Other (specify)
23. Does your firm have modern equipment for egg processing?
a. Yes
b. No
24. If no, what equipment would like to acquire for improving your firm productivity?
25. Does your firm process poultry by-products?
a. Yes
b. No
26. If No, what are the reasons?

27, If Yes, what are the types of by products and end products in your firm?

By-products types	End products

1. Feather	
2. Bones	
3. Feather	
4. Feet	
5. Viscera	
6.Egg shell	
7. Other (specify)	

Section 5: Business environment and processing innovations

28. Partnership with other Poultry value chain actors (Explain the service rendered or received)

Poultry value chain actors	Service rendered to or received from actors

29. What are the factors that mostly affect your business?

	Tick all that apply	**Comments**
a. Trade regulations (From RRA and RDB)		
b. Public policy conditions		
c. Processing quality requirement (RCVD, RALIS, RSB)		
d. Norms and Customs (Eg: Preferences by consumers)		
e. Infrastructures (Roads, water, electricity, etc.)		
f. Poor distribution chains		
g. Other: Specify		

30. Processing Innovation and creativity assessment

a. Source of innovation ideas		

Source	Yes	No
1. Are there Internal led innovations		
2. R&D Department		
3. Quality control department		
4. Production department		
5. Supply chain department		
6. Administration department		
7. Marketing & sales department		
8. Others		
9. External		
10. Clients driven		
11. Due to current competitors		
12. Suppliers		
13. Consultants		
14. Research institutions		
15. Universities		
16. Others (Specify)		

a. Degree/existence of innovation		
Source	**Yes**	**No**
Is there a new product on the local market		
New product on the international market		
Modification/improvement of existing products		
New products related to existing products		
New product with additional technical		

support		
Innovation in the supply chain (transport of raw material…)		
Innovation in primary processing (new technology…)		
Innovation in secondary processing (new technology...)		
Innovation in infrastructure (equipment, space and size)		
Innovation in knowledge use (education and training)		
Other (specify)		

31. Production challenges

	Tick all that apply	**Comments**
1. Limited energy, power and water		
2. Poor infrastructure		
3. Lack of raw materials		
4. Lack of skilled labor		
5. Lack of financial capital		
6. Lack of sufficient technology		
7. High taxes		
8. Limited demand		
9. Competition from other Firms		
10. Bureaucracy		
11. Other: Specify		

32. Do you have market competitors?

	Tick all that apply	Comments if any
Local competitors		
Regional competitors		
International competitors		
No competitors		

33. What strategies do you have to improve competitiveness?

34. What is the nature of contracts between the firm and supplies? (Tick what applies)

i.	Verbal	
ii.	Written	
iii.	Other (specify)	
iv.	No contract	

35. Does the contract specify any of the following? (Tick all that apply)

i.	Length of agreement	
ii.	Delivery and payment conditions	
iii.	Quality control measures	
iv.	Degree of contract formalization	
v.	Opportunities for enforcement of contractual obligations	
vi.	Non-financial and financial services provided	
vii.	Existence of sub-contracting	
viii.	Scope for changes	

36. What were the problems with getting access to finance for your poultry processing plant?

a. Lack of collateral
b. Loan maturity terms
c. Getting loan guarantee

d. Development of business plan
e. Commission and other extra payment
f. Submission of the required papers
g. High interest rate
h. Other

37. What is your current operational status?

a. Fully operational
b. Partially opened
c. Other

38. To what extent do you conduct your business in accordance to your business plan?

a. Completely
b. Partially
c. Fairly
d. Not at all

39. What are the main obstacles for your enterprise?

a. Shortage of inputs/technological assets
b. Sales
c. Access to finance
d. High cost of rent
e. Disruption of supply chain
f. Frequent inspections by state bodies
g. Availability of qualified labour force
h. Cost and quality of utilities (water, electricity,)
i. Other (Please specify)

40. Strategies set up to address constraints

Constraints encountered	Strategies used to address constraints
1.	1.
2.	2.
Etc	Etc,.

Annex 3. Questionnaire for technology audit of hatcheries or poultry seed producers

Section 1: General Information

1. Location and date of interview

Firm owner	E-mail	Interviewee Name	Province	District	Sector	GPS	Date	Work experience	Enum. Name

2. What is your highest level of education?

1. Completed Primary education
2. Secondary school certificate
3. Bachelor's degree
4. Master's degree/PHD
5. Other (specify)

3. Legal Status

Sole Proprietorship	Limited by shares	Limited by guarantee	Limited by shares and guarantee	Unlimited	None
1	2	3	4	5	6

4. Firm's ownership Composition

Ownership shares	Foreign	Private	Public Government

Section 2: Firm human resources and skills assessment

5. How many employees does enterprise have?

No	Range size	Ratio of males to females	Ratio of youth to adult employees
1	1 to 3 employees		
2	4 to 30 employees		
3	31 to 100 employees		
4	Above 100 employees		

6. Employees' skills assessment

Source	Number of employees	Number of employees with a university degree	Number of employees with a technical school degree	Number of employees other types of degrees	Number of employees who received further trainings/short courses in relation to the job	Comments
Permanent staff						
1. Supply/raw material reception						
2. Farm management						
3. Quality control						
4. Marketing and sales						
5. Administration						
6. Other (specify)						
Casual workers						

Section 3 : Hatchery Production capacity and Productivity

6. Types of day-old-chicks (DOCs) in production at the firm (tick all that apply)

a. broilers

b. layers

c. both

d. Other poultry seeds (specify):...

7. Source of DOCs

a. Parent stock reared at hatchery premises

b. Imported hatching eggs (specify the country of origin):...

8. Capacity of hatchery for broiler DOCs production in the last 3 years

Year	Number of broiler DOCs

2019	
2018	
2017	

9. Capacity of hatchery for layer DOCs production in the last 3 years

Year	Male DOCs	Female DOCs	Total DOCs
2019			
2018			
2017			

Note: Only Female DOCs are purchased by farmers for egg production

10. Hatchery performance in the last 3 years for broilers

Year	# set eggs	# recognized fertilized eggs	% of Fertility	# Fertilized eggs	# DOCs	% of hatchability	# delivered DOCs
2019							
2018							
2017							

11. Hatchery performance in the last 3 years for layers

Year	# set eggs in Incubator	# recognized fertilized eggs	% of Fertility	# fertilized eggs set in Hatcher	# DOCs	% of hatchability (=DOCs /fertilized eggs)	# delivered DOCs	
							Female	Male
2019								
2018								
2017								

Section 4: Markets and products sale information

12. DOCs' or other products sale Information

DOCs	Unit cost	Volumes (# DOCs)	Values (FRW)	Estimated share of total sales (%)
Broiler DOCs				

Female Layer DOCs				
Other product (specify)				
Total				

13. What is your product market? Indicate your major products destination in the last 3 years (market share in %)

Year	Local Market	Regional	Other (specify)	Market share in %
2019	1. 2.	1. 2.	1. 2.	
2018	Idem as above			
2017	Idem as above			

14. Do you have market competitors?

Response	**Tick all that apply**	**Comments**
Local competitors		
Regional competitors		
International competitors		
No competitors		

15. If No, what prevents you from competing favourably?

16. If Yes, what strategies can you put in place to compete favourably?

17. How do you access to market and market information?

a. Market Competition as Failure Factors

Statements	**Rankings**						Please note
	1	**2**	**3**	**4**	**5**	**6**	
Lack of marketing knowledge may contribute to the business failure							1= Very low influence 2=Low
Lack of competitive advantage over							

competitors may take business to failure							influence
Disregarding customer complaints may contribute to the failure of business							3=Modera te
Setting a lower or too expensive competitive price of goods contributed to failure							influence 4= High
Negligence to cultivate product awareness may contribute to failure							influence 5=Very
Lack of strategies about customer acquisition							high influence
Lack of strategies about customer retention							6= Have
Lack of value proposition where your product offers a higher level of value than your competitors							no idea
Lack of or have limited access to credible markets (local and regional and international market)							
Lack of knowledge about packaging and labeling locally made products							

Section 5: Business environment, source of financing, constraints and technological capacity

17. Partnership with other poultry value chain (PVC) actors

Poultry value chain actor/enabler/supporter	Types of partnership (explain briefly)
1. Commercial Layer and Broiler Farmers (5000 +)	
2. Poultry Inputs and vet services providers	
3. Enablers/regulators & Donors	
4. Enablers /Supporters	
5. Other (specify):................................	

18. What was the initial capital investment when you started your hatchery firm?

a. Less than 30million FRW
b. Between 30 and 50million FRW
c. Between 51 million and 71 million FRW
d. Above 71million FRW

19. Please give the financing status of the firm (in FRW) for the last three years as a share of the total financing

Year	Foreign financial institutions	Domestic financial institutions	Shareholders	State/government loans	Total
2019					
2018					
2017					

20. What is your Capacity level in your business?

Machine	Capacity (number of eggs to be set/cycle)	Number of cycle/year	Annual capacity (Eggs &DOCs /year)
Incubator			
Hatcher			
Other (specify)			

21. What constraints do you face in hatchery business?

Constraints encountered	**Remedial actions (specify)**
1.	
2.	
3.	
Etc	

22. How do you access to hatchery inputs such as drugs, vaccines, feeds and others?

Inputs	**Source**	**Comments**
1. Drugs		
2. Vaccines		
3. Feeds		
4. Additives		
5. Disinfectants		
6. Chick box		
7. Other (specify)		

23. Which of the following books do you use for accounting?

a. Journal
b. Cash book
c. Ledger
d. Sales book
e. Debtor book

f. creditor book
g. inventory
h. Profit and loss
i. Balance sheet
j. Other (specify)

24. What percentage of the business did you own when the business started?

Percentage owned	Percentage contributed by Bank loan	Percentage contributed by other shareholders/family
----------------------%	------------------------%	---------------------- %

25. Did you experience any obstacles shortly after establishing your business?

a. Poor cash flow management
b. Poor monitoring and control
c. Poor communication
d. Company organization
e. Poor record keeping
f. Financial constraints
g. Inadequate technology
h. Other (specify)

26. What were the problems with getting access to finance for your business?

a. Lack of collateral
b. Loan maturity terms
c. Getting loan guarantee
d. Development of business plan
e. Commission and other extra payment
f. Submission of the required papers
g. High interest rate
h. Other (specify)

27. What is your current operational status?

a. Fully operational
b. Partially opened
c. Other (specify)

28. To what extent do you conduct your business in accordance to your business plan?

a. Completely
b. Partially
c. Fairly
d. Not at all

29. What are the main obstacles for your poultry firm?

a. Shortage of inputs/technological assets
b. Sales
c. Access to finance
d. High cost of rent
e. Disruption of supply chain
f. Frequent inspections by state bodies
g. Availability of qualified labour force
h. Condition of local infrastructure
i. Cost and quality of utilities (water, electricity,)
j. Other (Please specify)

30. What are your poultry firm's Managerial and Financial Factors

Statements	**Rankings**						Please note
	1	**2**	**3**	**4**	**5**	**6**	
							1=Very low influence 2=Low 3=Moderate influence 4= High influence 5=Very high influence 6= Have no idea influence
Ineffective and inefficient communication with customers, suppliers, or other outside organizations							
The absence of or poor financial planning							
Less capital contribute to the failure of business							
The absence of financial records							
Lack of financial management skills							
Lack of leadership and human resource management skills							
Lack of risk management skills							
Lack of technical and business education							
Lack of IT management skills							

Lack of technical asset and their management skills							
Lack of skill to identify and prioritize the problems and opportunities							
Lack of adequate knowledge and access to public information on policies and programmes							
Lack of knowledge to require funding from financial institutions							
Lack of experience and lack of confidence in running the business							
Lack of creativity and innovation							
Customers' failure to pay their debts							
Poor participation in the policy making process							

Annex 4. Interview guide for members of focus group discussions (FGDs)

1. Which technology does your firm use to increase production
2. What strategies does your company put in place to promote technology and achieve sustainable development)
3. What kind of assistance /or sponsoring do you get for increasing income/ or production
4. Which raw materials necessarily to run your firm do you source in Rwanda and outside Rwanda?
5. Who are your company products main customers?)

5.1 Do you have any agreement with your customers?)

5.2 How do you access the market information?)

5.3 What strategies do you put in place to compete favorably with people in Rwanda or outside Rwanda performing the same business as yours?)

6. Do you register a profit or a loss in your company?
   6.1How do you know if your firm operates in profit or loss

7. How is your Company SWOT analysis?
   7.1 Which weaknesses prevent you from achieving business plan of your company?
   7.2 What are the sources of threats preventing your company from achieving objectives or targets of production?

8. How does your company impact on environment?

8.1 Is your business negatively affecting the environment like land use according to land master plan in your area of operation?
8.2.What measures of waste management used in your company?)
8.3 What measures do you apply for preventing/ or managing fire hazards in your firm?)
8.4 What are the sources of energy used for lighting in your company?)
8.5 What is your company source of energy used for heating)

9. Which institutions are you linked to among MINAGRI, RAB, NIRDA, RDB, RSB, FDA, RRA, PSF, RPIA, Banks, SACCOs, FAO, Enabel ?)
   9.1 What services do you receive from those public and private institutions in relation to PVC?)
   9. 2What partnership do you have with institutions and what aid do you expect to receive from them for developing the technology in your company?)
10. What is your company staffing?
   10.1 What is the current situation of staffing including permanent and casual personnel in your company?
   10.2 If, your firm does have employees, what is the ratio of females to males?

   10.4 What types of trainings provided to your company' employees for work efficiency and increase of income?
   10.5 What trainings do you expect to deliver your employees for good run of activities and increase of company production company?

Annex 5. Population and sample size of Poultry value chain actors

N0	Actors	Population size	Sampling technique	Sample size	Data collection tool
1	Large farmers	36	100%	36	Interview
2	Middle farmers	183	50%	127	FGDs
3	Small farmers	328	1 pers./sector	141	FGDs
4	Hatcheries	14	100%	14	Interview
5	Poultry seed producers (pullets sale)	16	100%	16	Interview
6	Poultry processors at plant level	2	100%	2	Interview
7	Small scale poultry processors	4	100%	4	Interview
8	Agro-dealers	84	100%	84	FGDs
9	Large scale feed processors (plants)	5	100%	5	FGDs
10	Small scale feed processors	7	100%	7	FGDs
11	Transporters	7	100%	7	FGDs
12	Wholesalers/distributors	4	100%	4	FGDs
13	Retailers	19	100%	19	FGDs
Total		**709**		**466**	

Annex 6. Numbers of PVC actors interviewed /or participated in FGDs

1. Interviews

Province	Planned interviews	Held interviews	Realization rate (%)
COK	23	20	87.0
Northern	12	8	66.7
Western	1	0	0.0
Eastern	25	15	60.0
Southern	9	4	44.4
Total	**70**	**47**	**67.1**

2. FGDs

Province	**Number of expected participants**	**Attended FGDs**	**Attendance (%)**
COK	42	25	59.5
Northern	38	31	81.6
Western	73	66	90.4
Eastern	156	114	73.1
Southern	85	50	58.8
Total	**394**	**286**	**72.6**

Annex 7. List of District Animal Resources Officers (DAROs)

N0	Names	Tel	E-mail	Institution	Position
1	Shumbusho Jean d'Amour	0788819788	Jadamour.shumbusho@nyarugenge.gov.rw	Nyarugenge	DARO
2	Mutetiwabo Peledicanda	0788467021	Peledicanda12@gmail.com	Kicukiro	DARO
3	Nzeyimana Pie	0783515669	nzeyimanapie@gmail.com	Gasabo	IDARO
4	Uwitonze Hyacinthus	0788218372	usecethi@gmail.com/hyacynthus.uwitonze@bugesera.goc.rw	Bugesera	DARO
5	Niyonagira Nathalie	0788630500	Ninatty78@gmail.com	Kirehe	DARO
6	Bugingo Gilbert	0788544297	Bugigil123@gmail.com	Ngoma	DARO
7	Uyisenga adolphe	0788539812	Uyado05@gmail.com	Kayonza	DARO
8	Hitiyaremye Valence	0783038763	h.valens123@gmail.com/valens.hitiyaremye@gatsibo.gov.rw	Gatsibo	DARO

9	Ngirinshuti Fabien	0788692978	ngirifa@gmail.com	Nyagatare	DARO
10	Niyitanga Jean de Dieu	0788629884	niyojado@yahoo.fr	Rwamagana	DARO
11	Nyirimanzi Theonsete	0783420855	nyiritheo1@yahoo.fr	Karongi	DARO
12	Sindayiheba Felix	0788762945	sindfelix@gmail.com	Nyamasheke	DARO
13	Niyonsaba Oscar	0788699333	niyonsaba6@yahoo.fr	Rusizi	DARO
14	Bizimana Francois	0788611894	bifraci002@gmail.com	Ngororero	DARO
15	Abayisenga Anselme	0788778129	anselmeabayisenga1@gmail.com	Rutsiro	DARO
16	Kalisa Robert	0788324049	kalirobertcla@gmail.com	Rubavu	DARO
17	Shingiro Eugene	0788457218	eushingi@gmail.com	Nyabihu	DARO
18	Nsengiyumva Bosco	0788613811	nbosconsenga@gmail.com	Musanze	DARO
19	Mukamwezi Adrolatha	0789199845	madrolatha@gmail.com	Burera	DARO
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22	Mukagasana Alphonsine	0783525408	mukagasana1987@gmail.com	Rulindo	DARO
23	Mwumvaneza Ferdinand	0788512519	mwuferdi005@yahoo.fr	Kamonyi	DARO
24	Kayiranga	0784450330	calliopekayiranga	Muhanga	DARO

	calliope		@gmail.com		
25	Rugwizangoga Dieudonne	0788532885	d.rugwiza14@gmail.com	Ruhango	DARO
26	Dusabimana Laurent	0788477700	dusabimanalaurent@gmail.com	Nyanza	DARO
27	Kalisa Aristide	0788682839	Ariska007@yahoo.fr	Huye	DARO
28	Nteziryayo Vedaste	0788977537	ntezvedastus@yahoo.fr	Gisagara	DARO
29	Twagiramungu Donatien	0788662980 /0783682969	twadona@gmail.com	Nyaruguru	DARO
30	Bizimana Jean Pierre	0783771377	Bipierre.j@gmail.com	Nyamagabe	DARO

Annex 8. List of Key Informants /Enablers

N0	Names	Tel	E-mail	Institution	Position
1	Eng. Rushigajiki Didace (Livestock specialist)	0788666098	rushidida@gmail.com	MINAGRI	Livestock Specialist
2	Dr Hakirumurame Savio	0785494779	Savio200@yahoo.fr	RICA	Animal products, feeds and premises Inspector
3	Dr Rwakazina Olivier	0788893502	rwakol@gmail.com	Radiant Insurance Company	In charge of insurance of animals, buildings, products and machines
4	Dr Hirwa Claire	0784824250	Claire.hirwa@rab.gov.rw	RAB	Senior Researcher & In charge of monogatsrics